THE

# ELECTRICAL REVIEW.

VOL. LI. OCTOBER 31, 1902. No. 1,301.

## "ELECTRICAL REVIEW."

Vol. LI.] CONTENTS: October 31, 1902. [No. 1,301.

| | Page |
|---|---|
| Breakdowns of Electrical Machinery ... ... ... ... | 725 |
| Notes on Recent American Installations ... ... ... | 727 |
| On the Efficiency and Power Factor of Small Three-Phase Motors (*illustrated*) ... ... ... ... ... ... | 728 |
| Correspondence:— | |
| The Voltage which Cannot Kill ... ... ... ... | 729 |
| Tramcar Brakes ... ... ... ... ... ... | 730 |
| Mechanical Engineers for Electric Generating Stations ... | 732 |
| Professional Etiquette ... ... ... ... ... | 733 |
| Students' Difficulties ... ... ... ... ... ... | 734 |
| Parliamentary ... ... ... ... ... ... ... | 735 |
| Business Notes ... ... ... ... ... ... ... | 737 |
| Manchester School of Technology (*illustrated*) ... ... | 742 |
| Prof. Sidney H. Short ... ... ... ... ... ... | 747 |
| City Notes ... ... ... ... ... ... ... ... | 752 |
| Stocks and Shares ... ... ... ... ... ... ... | 754 |
| Share List of Electrical Companies ... ... ... ... | 755 |
| Market Quotations ... ... ... ... ... ... ... | 756 |
| Traffic Receipts ... ... ... ... ... ... ... | 757 |
| British Association, Belfast, 1902:— | |
| Recent Progress in Large Gas Engines (*illus.*) (*continued*) | 757 |
| Institution of Electrical Engineers:— | |
| Notes on the Testing of Tramway Motors, and an Investigation into their Characteristic Properties (*illus.*) ... | 759 |
| The Physical Limits of Electric Power Transmission (*illus.*) | 761 |
| Metropolitan Electric Supply Company's Arbitration ... | 761 |
| A Study of Power Gas ... ... ... ... ... ... ... | 763 |
| New Patents ... ... ... ... ... ... ... ... | 764 |
| Published Specifications ... ... ... ... ... ... | 764 |

THE

UNIVERSAL ELECTRICAL DIRECTORY

1902 Edition

READY.

H. ALABASTER, GATEHOUSE & CO.,

4, Ludgate Hill, London, E.C.

THE ELECTRICAL REVIEW.

Published every FRIDAY, Price 4d.

*The Oldest Weekly Electrical Paper. Established* 1872.

TO BE OBTAINED BY ORDER FROM ANY NEWSAGENT IN TOWN OR COUNTRY.

OFFICE:—4, LUDGATE HILL, LONDON, E.C.

Telegraphic Address: "AGREKAY, LONDON." Code, A B C.

Telephone No. 933 Holborn.

*ALL Letters should be addressed to the Proprietors, H. Alabaster, Gatehouse & Co.*

ADVERTISEMENT RATES ON APPLICATION.

The "Electrical Review" is the recognised medium of the Electrical Trades, AND HAS

*BY FAR THE LARGEST CIRCULATION*

of any Electrical Industrial Paper in Great Britain.

*SUBSCRIPTION RATES.*—In Great Britain, Post Free per Year, 19s. 6d. To all other countries, per Year, £1 10s.

*BINDING.*—Subscribers' numbers bound, including case, for 4s. each volume.

*CASES.*—Cloth Cases for Binding can be had, price 2s. 6d. each; post free 2s. 9d.

*READING CASES*, to hold from One to Twenty-six Numbers until the volume is complete for Binding, can now be had from the Publishers, Price 6s., or Free by Post (in Great Britain), 6s. 6d.

*FOREIGN AGENTS.*—New York: D. VAN NOSTRAND, 23, Murray Street, Paris: VEUVE J. BOYVEAU, 22, Rue de la Banque. Berlin: ASHER & Co., 13, Unter den Linden.

Cheques and Postal Orders (on Chief Office, London), to be made payable to Mr. H. ALABASTER, 4, Ludgate Hill, E.C.

## BREAKDOWNS OF ELECTRICAL MACHINERY.

THE annual report of Mr. Michael Longridge, M.I.C.E., chief engineer to the Engine, Boiler and Employers' Liability Insurance Co., Ltd., on the insurance and inspection of engines, boilers, dynamos, &c., is always interesting and full of instruction, and that recently issued for the year 1901 is no exception to the rule. There is a lesson to be derived from every failure, even more cogent than from a dozen successes, and a few extracts from the report may be of service to our readers.

The number of insurances effected in the "Electrical Machinery" department increased for the year by 61 per cent., but the breakdowns increased in a still higher ratio —91 per cent. Many of the breakdowns were of small importance, but none the less annoying to owners and to the company. Two statistical tables relating to the breakdowns are of interest.

The causes of the failures were as follows:—

| | Dynamos. | Motors. |
|---|---|---|
| Accident ... ... ... | 12 per cent. | 7 per cent. |
| Dirt and neglect ... ... | 19 ,, | 23 ,, |
| Deterioration ... ... ... | 22 ,, | 16 ,, |
| Bad workmanship or design | 24 ,, | 14 ,, |
| Overloading ... ... ... | 4 ,, | 9 ,, |
| Unascertained ... ... | 19 ,, | 31 ,, |

The parts which failed were:—

| | Dynamos. | Motors. |
|---|---|---|
| Armatures and rotors ... | 78 per cent. | 60 per cent. |
| Magnets and stators ... ... | 8 ,, | 12 ,, |
| Commutators and brush-gear | 8 ,, | 14 ,, |
| Miscellaneous ... ... | 6 ,, | 14 ,, |

The number of breakdowns due to dirt and neglect is deplorable; this, however, is not so much due to the manufacturer, except in so far as he neglects to protect the vital parts of the machines against the entry of dust and moisture. A good deal can be done in this direction without incurring the expense of water-tight enclosure, &c.; there are far too many crevices and cosy corners about the average machine, in which dust and dirt are bound to accumulate, and which could easily be filled up with harmless material. The number of failures due to deterioration is formidable, and particulars as to the ages of the machines concerned would be of great interest and value. The worst feature of the table, however, is the excessive number of failures traceable to bad workmanship or design. We should like to see this item the smallest on the list, instead of being one of the largest. As it stands, it certainly reflects discredit upon manufacturers.

In the second table, one is not surprised to see that armatures and rotors occupy the most prominent position, as these are certainly the most vulnerable parts of the machines; it would be interesting, however, to learn the respective numbers of the armatures and rotors in question. Having regard to the attacks made upon the supposed weak point of D.C. machines—the commutator—by the advocates of polyphase currents, it is exceedingly significant that only 8

and 14 per cent. of the failures recorded in dynamos and motors respectively are ascribed to the commutators and brush gear. Bearing in mind that these numbers relate only to *failures*, the percentage of the machines at work which they represent must be extremely small. The supporters of direct current power supply may, therefore, take courage.

Twenty-two cases of breakdown are reported in detail, as examples of what is met with. The first of these relates to a 40-KW. D.C. motor-generator, transforming from 1,000 to 100 volts. In the course of his duties, the attendant accidentally caught one of the shunt connections with his coat, and pulled it out of a terminal. Violent sparking ensued, and the armature ran up to an excessive speed, the sole excitation being derived from a few turns of wire in series with the high-pressure armature, which were provided to help in starting the machine. The minimum current cut-out on the high pressure side then came out, and left the low-pressure armature as a dead short on the mains, which were presumably fed from some other source in addition. By the time the attendant had regained his presence of mind sufficiently to open the main switches, the armature, which was double wound, was burnt out, and the low-pressure fuse red hot. This fuse was set for 920 amperes, the normal maximum current being only 360 amperes—surely an excessive margin, even if the fuse were correctly adjusted. Apparently it must have been a copper fuse, since it attained a red heat without blowing. The commutator segments were opened out, besides being burnt, by the excessive speed, and, doubtless, the attendant had a narrow escape with his life—for when commutator segments fly, they fly like bullets. Mr. Longridge points out that a greater number of series turns would have prevented the excessive speed; they could be automatically cut out when the shunt winding was fully excited, and of course re-introduced in case of failure of the latter.

A still more apt suggestion in the report is that the shunt wire should have been coiled round the terminal, so that a mere touch would not have displaced it. In our opinion all these small connections should be soldered, or, at least, fixed with two screws; the factor of safety involved in the use of a single screw is absurdly small, having regard to the great importance of the shunt circuit.

Another failure was due to the slacking back of the nut—apparently there was no lock-nut—fixing the brush spindle on the rocker arm of a shunt motor. The carbon brush consequently fell almost out of contact with the commutator, and the heat generated by the sparking charred the insulating rings and melted the solder on the lugs, short-circuiting the armature, and involving entire rewinding. The omission of the lock-nuts at this point reflects no credit on the designer.

Instances of shocking depravity on the part of owners of machines are detailed, the former flatly declining to keep them clean, until the breakdowns, inevitable under such conditions, taught the owners common sense.

Other examples relate to smooth-core drum armatures, driven by two-crank single-acting engines, in which the insulation of some of the armature conductors was gradually abraded by slight movements, until short-circuiting ensued. In one case some of the conductors were partly let into slots in the core to act as drivers, and one of these was the source of the mischief.

A small machine which had run well for 11 years broke down by bursting of the commutator, the sleeve on which the latter was built having given way at an old crack.

A crane motor gave incessant trouble through the breaking of the commutator connections; it was eventually found that the brass armature spider had worked loose on the shaft, doubtless owing to the shocks incurred from the nature of the load. In another case the core was loose on the spider. Unduly loose-fitting of the commutator bush on the spindle has also caused repeated breakage of the commutator connections. Where evolute end connections are used, held in place only by their connections with the armature bars, relative motion between them rubs off their insulation and leads to short circuits; this can be remedied by tightly binding the connectors down upon suitable supports. Much trouble arises from the lodgment of carbon or copper dust in the interstices between the bars and the connectors at the commutator end of such armatures.

Breakdowns have occurred through the armature core discs being badly stamped and put together, so as to expose saw-like edges, which, moving under load, cut through the insulation of the conductors.

A three-phase induction motor of 5 H.P., with short-circuited rotor, repeatedly broke down, the soldered connections in the squirrel-cage being melted. The normal current was 9 amperes per phase, but on trial it was found that the current on starting or reversing ran up to something like 80 amperes, and no fuse smaller than No. 22 S.W.G. copper wire would stand, while this would carry enough current to make the rotor red-hot! In another case, one of the coils of a three-phase motor was burnt out, because fuses were inserted in *two* of the phases only; the burn-out was due to a fault in the mains, and took place while the motor was standing.

Speaking generally, Mr. Longridge draws attention to the numerous cases of serious damage resulting from oil entering armatures, due to inadequate oil-throwing devices, excess of oil in the wells, &c. Slackening of nuts is a serious cause of trouble. A still worse feature is the weakness of armatures, chiefly shown by lack of rigidity, which permits of small relative motions taking place between the parts; this defect is especially noticeable in machines used to drive loads subject to sudden variations. Breakages of steel wire bands from unexplained causes have been numerous. The accumulation of dust in end connections has been referred to above; Mr. Longridge recommends the simple precaution of attaching a short length of rubber tube to the nozzle of the bellows used to blow it out, to prevent injury often caused by poking the nozzle in amongst the insulated conductors.

Several cases where the thickness of brushes had been doubled, with a view to preventing sparking, were reported, some motor users being apparently of opinion that the designer did not know the right way to build a machine.

A delightful instance is given of a compound-wound dynamo used for lighting and for charging a battery, the series winding being cut out in the latter event. An automatic switch was provided, which would not go in if the polarity of the dynamo were reversed. One day it didn't go in, so the attendant held it in by hand! The consequences need no description. Mr. Longridge suggests that the series winding, which was doubtless the cause of the reversal, should be so connected that it would be impossible for it to be included in circuit when charging the battery.

The report concludes with a table of tests made on nine

four-pole semi-enclosed motors, which is of considerable interest, as showing the high efficiency and small heating obtainable in small machines. This table is reproduced on another page.

The Commercial Aspect of the Steam Turbine.

A paper on the steam turbine, as seen from the commercial point of view, was recently presented by Mr. E. H. Sniffin to the Detroit Convention of the American Street Railway Association. Commenting on the paper, the *Electrical World and Engineer* points out what a very serious difference in practice would have been brought about, or we might better say prevented, had the turbine grown to its present perfection a few years sooner. The dynamo was essentially a machine of quick rotation, and in early days all dynamos were belt-driven. Then the high-speed engine began to be used directly connected, and the wit of dynamo makers was concentrated upon designing machines to run as slowly as a direct-connected engine. The steam turbine has completely reversed all our previous difficulties, and its designers have had to labour in the opposite direction so as to meet the conditions of the dynamo designer, who, having got down to moderately slow speeds, is now called on for fast-running machines, as in the early days.

On the commercial side, the turbine requires less space than either horizontal or vertical engines, not merely in plan but in elevation, and lofty engine rooms need no longer be employed. As regards foundation, the ratio is as 1 to 9 and 15 respectively, as compared with vertical and horizontal engines, and in cost as 1 to 3 and 5, while, as regards buildings, the turbine demands but one-half the cost of buildings for ordinary engines.

Turbine makers appear to desire to sell the dynamo portion also, so that it is possible that the near future may see engine makers entering the field of dynamo construction. It would thus appear that a prominent English maker of alternators has once again probably been a little ahead of the rest when he took up engine building also. There will be a certain satisfaction in being no longer tossed between the engine builder and the dynamo maker when anything goes wrong.

It seems probable that turbines alone are still more costly than ordinary engines, but that the smaller high-speed dynamo helps to equality. But even then, what with foundations, buildings and smaller boiler plant, and economy, the turbine has a great advantage, and where more power has been demanded, the turbine has even been arranged in the spare room of an old station which could not possibly have accommodated ordinary plant. At Akron, in Ohio, an engine room planned for 2,000 KW. is found sufficient for 5,000 KW., and an economy of one-third is expected in the boilers, because of the better efficiency of turbines. Nearly 12s. per KW. was saved on foundations alone.

The economy of the turbine does not desert it through a wide range of load, and this ought to render it specially applicable to traction work. The Americans seem to be taking hold of this English invention in steam engines, and duly to appreciate its freedom from the necessity of lubrication internally, and its capacity to use superheat of any rational temperature. The American makers are building turbines of 4,000 KW. for New York, and other sets of 5,000 and 3,500 KW. are in course of construction for the Metropolitan and District Railways of London. We should not be surprised to see the turbine make rapid progress in America. It will suit American manufacturing methods and materials in a way that the high-speed engine will not.

## NOTES ON RECENT AMERICAN INSTALLATIONS.

By FRANK BROADBENT, M.I.E.E.

### I.—The Fore River Shipyard.*

What is described in the *Electrical Review*, N.Y., as "one of the finest examples of electrical power distribution that has yet been erected" is the installation at the Fore River Shipyard. It is now pretty generally recognised that shipyards worked on the old lines are among the most wasteful examples of power distribution that it is possible to find. Owing to the large number of auxiliary engines scattered over a large area, necessitating long lengths of steam piping, very often uncovered, and to the rough-and-tumble makeshifts in the nature of shafting and tools, the efficiency of the power system is so low, that there is in many cases very little difference in coal consumption, whether any useful work is being done or not. In such a case it would be almost impossible not to show a considerable saving by a conversion to electrical driving, even if the electrical system were not put down on the most economical lines. In the Fore River Yard, which covers 78 acres of land, and has a frontage of $1\frac{3}{4}$ miles, the various operations necessary to the building of a modern vessel are carried out in 14 large buildings, besides many small ones, having in the aggregate a floor area of about 11 acres.

A special feature of the yard is the "ship house," a huge skeleton erection supporting travelling cranes, which run fore and aft over the ships in course of construction. This is a feature which has not yet met with anything like general adoption in this country. In most cases it is necessary to lift any heavy piece of machinery or work on board before the launching of the vessel, by blocks and tackle rigged up to a temporary derrick. As a rule, however, very little machinery is erected before the launch, nor is any work carried out that can be done afterwards. The boat is launched practically as soon as the hull is completed, and the stocks are then available for a fresh keel to be laid down.

One of the few English yards containing a ship house is Swan & Hunter's, and in this case the house is provided with a roof, which permits work to be carried on right through the winter, when many other Tyneside yards are laid idle by snow. Ramage & Ferguson, and other yacht-building yards, too, have covered ways, under which the craft is built, but a yacht is often practically completed on the stocks, and when launched, is almost ready for the owner. Still, there is no doubt that the use of travelling cranes saves a considerable amount of labour and time during building; although ship houses are few, gantries, equipped with electric cranes, are becoming more numerous. A crane gantry, running transversely across the "ways," has been in use for many years at Stevens's yard on the Clyde. By this means one crane suffices for several ships, and is more constantly employed than separate cranes arranged to travel fore and aft over each ship.

The power house at the Fore River yard does not call for much comment; in some respects it is behind English practice. One interesting feature, however, is the multiple-voltage motor-generator. This is given as of 50 H.P. capacity. The photograph of the machine shows it to have two armatures, one of which is double wound.

The voltages of these three windings are respectively 60, 80, and 110 volts. A four-wire system is run from the machine, and it is apparent that, in addition to the three voltages named above, two others may be obtained by connecting the middle armature (80 v.) in series with one or other of the outers, and a sixth voltage by connecting right across the outers. The pressures obtainable are 60, 80, 110, 140, 190 and 250. Machines requiring wide speed variation are connected up to this system through suitable controllers, when six speeds are obtainable without the use of resistances. Intermediate and higher speeds are obtained by means of shunt regulation, the shunts being excited from the outers at 250 v. Thus a variation in speed in the ratio

*(*Electrical Review*, N.Y., 40, pp. 527—532.

of 6½ to 1 is possible without the use of wasteful resistances. Obviously such a system is only possible where the power required is approximately proportional to the speed, unless the motors have a sufficient margin of power when running at their normal speed at the full voltage, and with full field strength. This system—known as the Bullock system—is in use in this country to a limited extent in connection with the driving of printing machinery. Whether or not the extra expense and complication pays for itself in the saving of energy consumption is a matter that requires working out for each individual installation.

In the power house is also an air-compressing plant for actuating the pneumatic tools, such as hammers, drills, caulkers, &c. This consists of two compressors, having capacities of 1,000 and 5,000 cub. ft. per minute respectively, and of the Rand and Ingersoll-Sargent type.

The aggregate power of the motors, numbering 175, varying from ½ to 150 H.P., is approximately 2,000 H.P., whilst the average daily load on the generating plant is in the neighbourhood of 400 H.P. for both lighting and power. The lighting embraces 165 arcs and about 2,000 incandescent lamps.

As to the method of application of the motors to the tools, about 75 per cent. are geared direct, some are belted, and, in the wood-working department, a few are counter-belted to obtain the high speed necessary.

The mains to the various centres of distribution are run in masonry subways large enough for a man to walk in. In the ship-tool shop where the plates and heavy steel work used for the hull are handled, the controlling switch gear for all the motors is placed on an elevated gallery from which every tool is in full view. This enables the workmen to devote all their attention to the work in hand, many of the operations requiring great skill and undivided attention, and leaves the control to the switch attendant, just as done in the case of a three-motor crane. This method has the further advantage that the switches cannot be damaged by coming in contact with heavy plates, &c. A special tool worth notice is a portable counter-sinking machine. In the ordinary way about three men are required on this work, two to handle and guide the plate, and another to operate the countersink. By means of the portable counter-sinking machine one man can do the whole thing much more quickly.

The motor geared to the drill stock holding the counter-sinking tool, is mounted on a light two-wheeled trolley, which can be run on the plates and moved about easily, the countersink being pressed down by hand into the punched holes. Travelling cranes for handling the plates are used in the plate yard, one having a clear span of 150 ft. and a run of 700 ft., said to be the largest of its class in the world.

II.—Electrical Driving of Electrotyping Plant.*

The application of motors to electrotyping machinery is of comparatively recent date, although, owing to the very intermittent nature of the work, some machines standing idle for many days together, and to the large amount of shafting and belting necessary when driven from an engine, it is a department which should show very marked economy by the substitution of electrical methods. The conditions imposed on both motors and switches are, in some cases, very severe, the toggle-power moulding press being a case in point.

In the ordinary way this is driven by open and crossed belts operated by a striking gear much in the same way as a shaping machine, as it is necessary to reverse very quickly the driving shaft. Very frequently, when machines of this nature are electrically driven, the mechanical reversing gear is retained, the motor running in one direction only, driving a countershaft. This simplifies considerably the electrical equipment and reduces to a minimum the strains on the motor. It is really questionable if much is gained in the long run by gearing a motor directly to a machine of this sort. In this instance the motor is mounted on a curved cast bracket, bolted to the top of the moulding machine, and drives down on to the machine shaft by means of chain and sprocket wheels. On starting, it must accelerate to full speed very quickly; then, at the moment when the press is exerting its maximum pressure, and the necessary depth of impression has been reached, as indicated by a pressure gauge, the motor is reversed, and then stopped within a short space of time. A 2-H.P. six-pole slow-speed compound motor is used, and, from tests that have been made, it is found that, for a few seconds, 16 H.P. is exerted.

The screw-driven metal shaving machine operates practically in the same way as a shaping machine, in which, as is well known, the travel of a tool is regulated by stops which actuate the belt-shifting gear. Instead of a belt-shifting gear, a reversing rheostat is actuated by a travelling rod.

In shaving a short-plate, the travel of the shaving head is so limited that the motor barely reaches its full speed before it is again reversed. The motor is mounted under the machine and drives by belt on to the machine shaft. The application of motors to routing machines is not so recent. For this purpose a vertical motor standing on the floor drives upwards through an extension of the spindle on the commutator end. The principal feature is that as the operator needs to have both hands at liberty, the starting and controlling switch is operated by treadles.

The desire to reduce shafting and belting to a minimum in order to economise power and make a compact self-contained equipment is very natural, owing to the wonderful adaptability of the electric motor, but this may be carried too far, that is, to a point where the wear and tear and cost of renewal exceeds the value of savings in other directions.

* *Electrical Review*, New York, 40, pp. 470—471.

## ON THE EFFICIENCY AND POWER FACTOR OF SMALL THREE-PHASE MOTORS.

When a large number of small polyphase motors are used in connection with a three-phase supply from a town electricity works, the question of their proper performance becomes of the greatest importance. In order that the plant and mains may not be loaded up with wattless currents, the power factor of the motors connected up must be high over a wide range of load, for it must be remembered

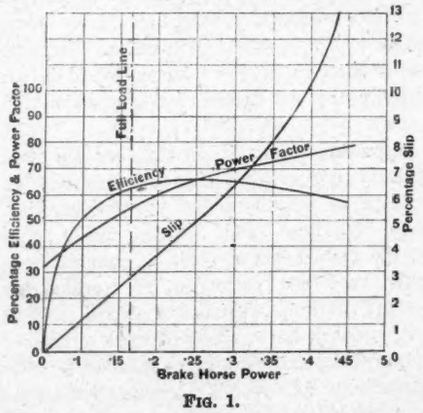



Fig. 1.

that these wattless currents not only waste energy right through the system, but they impair the pressure regulation of the circuits as well, on account of the increased pressure drops brought about by them in the generators and transformers. On the other hand, from the user's point of view, a high efficiency and large overload capacity are of the first importance, the nature of the power factor being more or less immaterial to him, because the lagging component of the current absorbed by the motors is not taken into account by his meter. The usual class of industrial work is of a more or less intermittent nature with regard to the amount of work the motor has to do, and therefore, from the user's point of view, it is an advantage to underrate the motors, overloading them fairly frequently, in accordance with the requirements of the work. By doing this, the motors will be working on the average load at their highest efficiency, and the latter will be high over the working range of the

motors, which will rarely, or never, be underloaded. In this way the cost of working will be a minimum.

From what has been said above, it will be seen that the joint requirements of the central station engineer and the user of the motor are such that they can only be complied with by really first-class machines. The former wants high power factors, and does not care about anything else (apart from the question of starting currents), while the latter does not care about power factors, but wants great overload capacities and high efficiencies at all loads and overloads; so that, between the two of them, the constructor of the motors has to bear the following points in mind:—

1. The power factor of the motors must be as high as possible at all loads between ¼ load and 25 per cent. overload.

2. The efficiency of the motors must be not only as high as possible at full load, but it must be reasonably high already at ¼ load; that is, the efficiency curve shall be as flat as possible, rising steeply at the small loads.

3. The motors should be capable of carrying double their normal full load for short periods, without falling out of step, and without overheating.

4. The last requirement means that the temperature rise of the motors must be moderate after running for several hours on full load. Small losses (required by condition 2), combined with adequate ventilation, will ensure this.

In order to show how the above requirements are fulfilled in actual practice, we give herewith a series of curves (see figs. 1 to 5) relative to five sizes of small induction motors of the latest Kolben type. The curves in question represent the results of a series of careful tests carried out by Mr. Novak, of the Prague Technical University. For convenience, the principal results of these tests are tabulated in the schedule below:—

| Rating of motor. | Maximum load before falling out of step. | Full load efficiency. | Efficiency at 50 per cent. overload. | Full load power factor. | Full load slip. | Temperature rise after 4 hours' run at full load. | Weight of motor. |
|---|---|---|---|---|---|---|---|
| H.P. | H.P. | % | % | | % | °C. | lbs. |
| 0·165 | 0·28 | 65 | 60 | 0·7 | 7·1 | 30·5 | 72·5 |
| 1 | 1·6 | 81 | 73 | 0·82 | 3·8 | 19 | 143 |
| 2 | 3·6 | 82·4 | 79 | 0·85 | 2·84 | 16 | 194 |
| 3 | 6·6 | 86·4 | 85 | 0·85 | 3·05 | 30 | 265 |
| 5 | 10·0 | 88·3 | 87 | 0·88 | 2·85 | 36 | 352 |

All the above motors are built with permanently short-circuited rotors of the special construction shown in fig. 6. Starting upon a loose pulley, the current consumption does not exceed the value at full load; starting with full load torque, the current consumption is about twice the full load current.

As will be seen from an inspection of the figures and curves, they show that the modern well-built polyphase motor entirely fulfils the conditions which have to be complied with in high-class work. Great progress has been made in the design of such motors during recent years, and it will be seen from the particulars above that small motors can be obtained, whose performance, from all points of view, leaves little to be desired.

A. C. E.

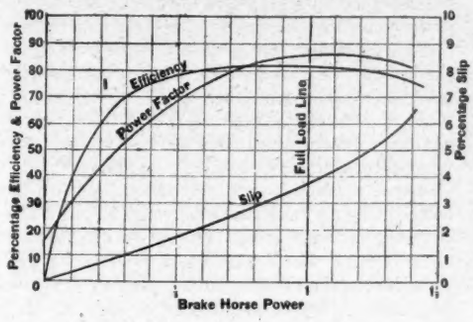



Fig. 2.

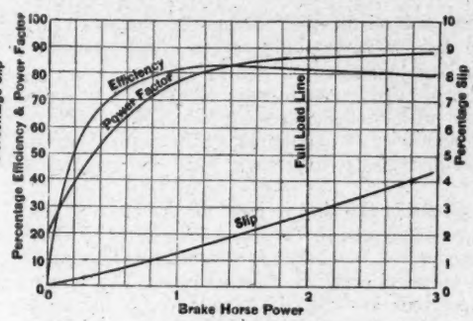



Fig. 3.

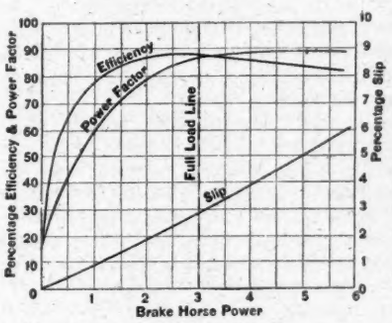



Fig. 4.

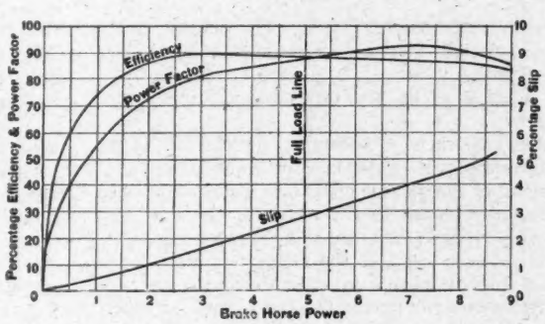



Fig. 5.

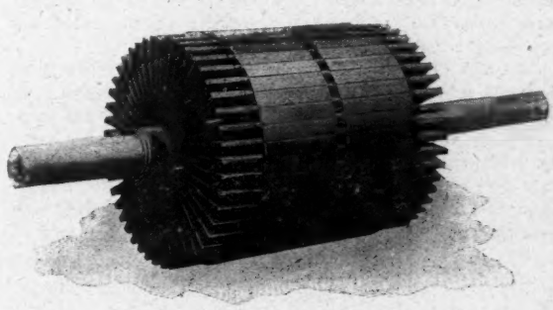


Fig. 6.

## CORRESPONDENCE.

### The Voltage which Cannot Kill.

I take the following from the October 17th issue of one of your contemporaries:—

**The unfortunate fatal accident which occurred at Sutton Coldfield last Friday need not unduly alarm our readers, nor the public, which is uninitiated in electrical matters. It will be seen from the report of the inquest in another column of this issue that a workman employed on the electric lighting mains fell against a conductor charged *at* 235 *volts*, and was found to have expired. He remained in contact with the wire eight or 10 seconds. The medical evidence was to the effect that the man suffered from heart disease, electric shock being a contributory cause of death, and the verdict of the coroner's jury was in accordance with this statement, although the evidence of the *borough electrical engineer was that the low voltage***

*could not kill.* We should not like to deny that the actual shock experienced by the victim may either have brought on the attack of syncope or have contributed to his death, but we are not inclined to go so far as to say that any electrical effect on the system played a part in it. If the shock had been from a mechanical or mental cause, instead of an electrical one, the result would probably have been the same.

The desire evinced in the concluding paragraph to attribute the fatality to anything but an electric shock is delightful in its artlessness.

What mechanical or mental cause corresponds to a 10 seconds contact with a conductor charged at 235 volts? A fall from the fifth floor of a building, or the state of mind brought about by trying to understand your contemporary's logic!

I should have thought that in view of the positive and direct evidence we possess, that voltages considerably lower than 500 have proved fatal, such a statement as that attributed to the electrical engineer in question would have been impossible, and still less should I have expected that such an opinion would have found an echo in any responsible electrical journal.

Doubtless such expressions, wholly at variance with experience, are primarily due to the fallacies existing in that misleading Institution paper of Mr. Trotter's "Shocks from 500 Volts," fallacies which you exposed at the time it was read and discussed.

Mr. Trotter has such a charming personality, is so thoroughly in earnest, of such sterling worth and ability, and so fully possessed of the courage of his own honest opinions, that one naturally hesitates to say anything which he can possibly consider unkind; but, unless I am much mistaken, he will yet have reason to regret the reading of that paper with its accompaniment of sensational experiments; and, let us hope, to very materially modify the conclusions at which he then arrived.

The reports of verdicts of coroners' juries, and the results of *post-mortem* examinations which are continually meeting one's eyes in the daily press, give very convincing evidence that an alarming percentage of our fellow creatures, both men and women, who go about their daily occupations as if nothing ailed them, suffer with what is known in medical parlance as "hearts;" indeed, the fact is well understood in medical circles.

Just as we consider the weakest link to be the strength of a chain, so should such individuals be looked upon with regard to humanity, and any attempts to decide what is, or is not, a voltage which could not kill, should be based upon what is likely to happen to the numerous and unfortunate people who are afflicted with various forms of heart affections, and not upon the physically strong, robust and healthy.

M.I.E.E.

---

### Tramcar Brakes.

Much as I admire Mr. Phillimore's lucidity of style with which he follows up the point he had in view in writing his article, I cannot agree with him that it will make matters much better than they are at present, however well motormen are trained, so long as such outrageous demands are made upon these men's limbs and senses, as six movements, a simultaneous bestowing of attention for keeping a lookout and attending to the guard signals, constitute.

Mr. Phillimore expresses the hope that many accidents will be averted in the future by our being able to give the drivers more command over his cars, but I fear we shall have to wait a long time for these improvements, unless considerable pressure is brought upon tramway managers to induce them to at least study the subject.

I, therefore, Mr. Editor, welcome the suggestion you made recently to discuss this subject in your columns. It looks to me that the first question to be decided is, which system promises at present to solve the problem most satisfactorily?

I suppose it will be acknowledged that the hand brake alone is not sufficient on a heavy tramcar, and the choice therefore lies between electric and magnetic brakes on the one hand, and brakes which employ elastic mediums, such as compressed air, on the other.

Electric and magnet brakes have had their chance; they have been 12 or 15 years in use, and are still as complicated to handle as Mr. Phillimore has signally succeeded in demonstrating. They have most probably only held the field so long because every brake designer will first think that having electricity on board the car, it should be used as much as possible, and that the employment of a second medium would mean complication, and most probably more expense.

Comparatively few tramway engineers have gone beyond this superficial consideration of the subject, or have actually tested more than a number of modifications of the electric brake. Amongst those who have done so, we find the engineers of the Berlin tramways, who have tried electrical, magnetic and air brakes, and who also inquired into the question of wheels or track brakes independently, or whether they were actuated by electricity or other medium, and the conclusions they have arrived at are certainly worth considering if one bears in mind that Berlin has very dense traffic, very greasy rails during the greater part of the year, heavy cars, employs high speeds, and that these cars have to be braked very frequently, and very often very rapidly.

These results are the more remarkable as they had an abundance of excellently disciplined men to choose from for their motor cars equipped with electrical brakes, and, as everybody knows, do not grudge them the drill which Mr. Phillimore advocates.

After testing a hundred cars equipped with a good air brake against the remainder of their stock, which was partly equipped with electric and partly with magnetic brakes, for one year, they have decided in favour of the air brake, and the following are the reasons which they give:—

1. The braking is as efficient as can be desired, and without discomfort to the passengers. Air being an elastic medium, however quickly it is admitted to the brake cylinder, it still acts gently.

2. With greasy rails air affords greater facilities for sanding the rails simultaneously with the application of the brake blocks, and without any extra special action on the part of the motorman.

3. The motormen like the air brake, handle it better, and there are very marked reductions in claims and inquiries, leaving the manager and his chief assistants time for other purposes.

4. There is a considerable reduction in motor and controller repairs, because the motors have time to cool down while descending hills and are—together with the mains and other plant in many cases where electric and magnetic braking is resorted to—far more strained by the braking than by starting and running.

5. The reduction in upkeep of tires, because it is easy to adjust the maximum air pressure so as to prevent skidding. The diameter of the brake cylinder being given, only a certain maximum of brake pressure can be exerted with a given maximum of air pressure, and if this is insufficient to lock the wheels, skidding cannot take place.

6. As it makes only very little difference in the cost whether more or less air is expended for braking, the air brakes are used as working brakes in Berlin, and not as emergency brakes only. This is a very important point, as the motorman is thus kept in practice, and loses no time in an emergency.

7. Another advantage is that the handling of the air brake means no effort at all to the motorman, and he, therefore, puts it on early enough, and does not wait till the last moment, as with the hand brake, where they want to save the muscular effort, which is not inconsiderable if carried on throughout the day.

All these advantages have been confirmed in other towns, and the total number of such air-brake equipments in use is stated to be over 2,500, which should certainly induce British managers to study the system and to give it a trial.

Compressed air has the advantage of enabling a gauge to be fixed in front of the driver, from which he can always see whether his brake is in good condition.

The most ignorant of motormen can clearly understand how it works, and that it cannot possibly hurt him or the car. Whenever and however he leaves it if he thinks it is out of order, he knows he can do no harm by using this hand brake, and this seems to me one of the most important points in favour of the air brake, as compared with electric brakes.

The first and most natural impression the motorman has if the electric brake does not seem to act, is that he may have made a mistake, and that the car may be set on fire if he puts the hand brake on while the controller handle is in a wrong position, and the next moment it strikes him that one of the cables or connections may have gone wrong, and that the car may already be on fire.

I have heard tramway managers pooh-pooh this view, but they had advised their committees to buy cars with electric brakes, and not all tramway managers are heroic enough to revise their views from time to time, and some not even after they have had serious accidents.

Mr. Phillimore thinks with the Board of Trade Inspector who reported on the Huddersfield accident, that the shortcomings of electrical brakes can be largely overcome by the better training of motormen; but the inspector can have no faith in electric brakes, as he states in his report that though he could trace no defect in the controller contacts or connections, there may have been a *temporary failure* in this respect. How can a motorman have confidence in such a system? Who can say that there was no danger of the car catching fire?

Having chosen between air and electricity, the next question to be decided is track, wheel, or pulley brake?

Both theoretical considerations and tests show that quick and smooth braking can be obtained by either of these arrangements, but practical results differ very much. This divergence of opinion is most probably largely due to oversight of details on the part of those who design and use brakes, and chiefly to the want of appreciation of the *specific brake pressure*, viz., the pressure per square inch obtaining between the brake block and wheel or rail. If we consider the working of an ordinary planing machine we shall quickly appreciate this.

There is the same total pressure with which the planing cutter rests on his work and which the table exerts on the bed, but the pressure per square inch on the point of the chisel is very large, while the pressure per square inch between table and slides is very small. The consequence is, that the wear and tear of the slides is a minimum, while the wear and tear of the work is cuttings.

If a track brake block is properly shaped and of suitable dimensions, it has an advantage over a badly designed brake block on a wheel—other circumstances *supposed* to be equal. I say "supposed," because generally they are not equal. Take, for instance, wheel blocks and track blocks of the same size and material applied with the same pressure, the one on the polished surface of a chilled wheel, and the other on the comparatively soft and dusty surface of a rail. The result will seem to be in favour of the track brake till the rails will require renewing. Then the track brake enthusiast will, to his dismay, find that it would have been cheaper to use tired wheels and to renew them when worn down.

Another serious drawback of the track brake is, that it takes the pressure off the wheels and makes these liable to leave the metals when entering curves. This danger is accentuated if the rear part of the car is heavier laden than the front. The track brake blocks then form the fulcrum round which the car tilts, and the front wheels are almost lifted off the rails, the leverage being much more favourable for this than as long as the hind axle forms the fulcrum.

Where the track brake beats the wheel brake is in experimental effects, simply because any flat track block fits a rail, while the curved wheel block requires fitting or wearing into shape before the *proper* specific pressure is permanently secured.

As regards pulley brakes, they would be preferable to either the wheel or track brake, as they could be kept free from dirt, which causes the specific pressure between blocks and wheels to vary, and considerably increases wear and tear. They are, however, not always easily applicable, and rather more costly than tramway managers are likely to pay.

The pressure of price has been to a large extent responsible for the inferior brakes used, but fear of a rise in insurance premium will set this right.

**Air and Sand.**

---

The subject opened up by Mr. H. B. Phillimore, and furthered by Mr. W. Arnold Ogden, is matter worthy of, at least, the exchange of experiences and the expression of opinions. I am not altogether with these gentlemen in considering the slipper brake useless for emergencies, and, further, as the following experiences confirm, think that Mr. Ogden has been much too liberal in bestowing 10 seconds as the time required to actuate such a piece of mechanism.

My firm, a few months since, was entrusted by the British Electric Traction Co. to make and equip a number of cars running at Tynemouth and District with slipper brakes. The weight of the cars loaded was approximately 8 to 10 tons, and they were of the Baltimore truck type. The brake was actuated by a lever placed on the car platform. One of these cars, artificially loaded, was allowed to run free down a gradient of something near 1 in 10 or 1 in 11, and when a speed largely in excess of legal limits was attained the position was noted, wheel brake applied, and slipper brake lever pulled over immediately afterwards by the same individual, when it was found the car had been brought up in a little over the car's length. It was computed that the slipper brake was brought into use in two seconds, and the car held firmly whilst on the grade.

The slipper brake was designed to exert a pressure of 3,000 lbs. with a pull of 125 lbs. in the lever. This latter, however, was considerably exceeded very easily by the assistance of the leg and foot against the dash, with, of course, a corresponding increase of pressure upon the rails. Such retardation would, to my mind, bring certain discomfort to passengers, and lively recollections of the experience would remain for some time to come, and if made common practice, would mean building cars of greater rigidity, for it has come within my experience that considerable damage can be done to car and truck framework by the sudden application of powerful slipper brakes when travelling at even limited speed.

My firm, upon the results obtained, have now supplied to the Electric Railway and Tramway Carriage Works, Preston, similar brake equipment for the Gravesend cars. They have also designed lever actuated brakes exerting a pressure of 8,000 lbs. for either single truck or bogie cars, also a wheel and worm application suited to either form of car and capable of exerting 20,000 lbs. within respectively two seconds and four seconds; but the best of appliances, whatever the means, are useless without the right man. The driver must be trained, and must not be of those who would in emergency, be lost as to how he should immediately act.

A word about training a man. What would be thought of the railway company who selected ticket collectors or porters, gave a few weeks' training and then made engine drivers of them? This, however, is just how the electric car driver is manufactured; taken from the post of conductor, put on the front under tuition for a short period, then has the lives and well-being of passengers and others absolutely dependent upon him. The conductor is, no doubt, a very excellent fellow, but can it be expected that such a faulty and meagre system of training can bring anything but great risks and disaster in its train.

My suggestion is that the drivers should be trained under similar, though somewhat modified, conditions as adopted by the railway companies. Here the man before he even boards an engine as fireman has a good all-round knowledge of the apparatus he is to be called upon hereafter to control.

Mr. Ogden confesses a certain amount of faith in pneumatic brakes, but I believe I am correct in stating that several systems of this nature have been tried, and for various reasons found unreliable and deficient. I have heard that the Potteries cars had such brakes attached at great cost, but they were discarded through unreliability and the abnormal cost in upkeep, and were replaced by mechanical brakes. I should also imagine that the pneumatic brake would not be without complications due to atmospheric conditions.

Summing up, it is my belief that greater security and true economy is best obtained by putting the proper sort of man in control. Give this man the ordinary wheel brake, and a slipper brake for emergencies, and I am confident little fear need then be felt for the future.

**J. W. Manley, A.M.I.E.E.**

*The United Engineering Co., London, W.C.*

*October 22nd*, 1902.

The correspondence in your columns with reference to track brakes is becoming extremely interesting to all those who have any connection with tramway work.

The efficiency of the Hewitt & Rhodes slipper brake, both for service work and emergency purposes, is beyond dispute, and is freely admitted by all those who have used it, or seen it used, and I therefore don't propose to make further comment on it; but there is one aspect—a commercial one—which, though not noticed, or at least not mentioned by your correspondents, must appeal strongly to those having the control and responsibility of electric tramways. I refer to the saving of both track and rolling stock ensured by the use of this brake.

The life of the wheels on roads where stoppages are frequent, or where steep gradients are encountered, is often not more than 9,000 or 10,000 miles, due to the fact that flats are caused by the use of the hand brake. Not only is this fatal to the wheels, but to the whole car, as well as the track. The jolting due to flats tends to loose the electrical connections, and perhaps fracture them, thus causing many a motor to be condemned for short-circuiting when it is really the fault of the brakes; but the track also suffers to an extent that, owing to the recent introduction of electric traction, has not yet been fully realised, and in time will lead to the necessity of relaying the permanent way in much less time than allowed for in depreciation expenses.

In one case, in my knowledge, the life of the wheels has been more than doubled by the use of the brakes I have mentioned.

Now, if we look at this question simply as a matter of £ s. d., if we are to study economy, we shall find that two sets of wheels per car are saved per annum. Each set of wheels average, including fitting, say, £11, thus a saving £22 per car yearly is the result, over and above enabling the car to be working a greater number of days in the year, and therefore having a larger earning capacity. There is also the saving in wear and tear of the car body and truck, which cannot be so easily estimated with our present limited knowledge, but which is bound to amount to no inconsiderable sum.

I quite agree with your correspondent "Driver" that the hand brake is an out-of-date article in these days when everything is done by power, and his suggestion to use it in conjunction with the slipper brake is decidedly good. I differ from him, however, in the order of the brakes; that is, I would have the slipper brake brought into action first, then, by turning the handle further round, bring the wheel brake into use.

In this way the wheel brake would only occasionally be used, and no appreciable harm could be done in the shape of making flats.

By this means a great saving would be made in wheels, trucks, car bodies and tracks, although the combined power of the two brakes is there, should the necessity occur to use them both.

**Engineer.**

---

On carefully reading the letter *re* above over the signature of Mr. Roberts, I think it advisable to draw the attention of those interested in this correspondence to a few facts. First, I don't think the electro-magnetic brake-track brake has been overlooked. I mentioned it, and also its disadvantages compared with the "Hewitt & Rhodes Pneumatic Brake," in your issue of March 28th, 1902. Taking his first assertion that the slipper brake is entirely wrong in principle, I do not agree with him. The Hewitt and Rhodes brake is not only correct in principle, but works perfectly in practice; it brings the car quickly to rest without going to its extreme limits, but supposing the car did become entirely borne (which is impossible) by the track shoes, how long does he think it would be before it came to rest? It would not travel many feet I can assure him. The fact that the Hewitt & Rhodes brake acts as an air cushion which is elastic in its movements, always keeps the car body resting on the wheels, and not on the brake shoes. As regards his next claim for it, *re* greater the speed, the more effective the action; now what I presume he considers a strong feature and claim for it, I consider is one of its weakest features and open to severe criticism, because its efficiency is decreasing all the time the speed is decreasing, which must, of course, prolong the time or distance in that proportion in which a car comes to rest. Its power and efficiency should be constant, always at a maximum and not decreasing.

Next take the times and distances travelled before it brings a car to rest; just realise the absurdity of a car having to travel from 25 to 55 yards before it comes to rest; the accident is generally all over by that time. What is required is to bring the car to rest in less than as many feet? There is only one brake that will do it, and that is the pneumatic brake.

The Hewitt & Rhodes brake can be adapted to any kind of truck, either single maximum traction or equal-wheel trucks.

A great disadvantage of the electro-magnetic brake is the fact that it depends upon the rotation of the generating apparatus while the car is in motion, which is a constant varying quantity and does not always act. Now, if it was energised from some independent source of electrical energy, such as a storage battery, it would be greatly improved. The pneumatic brake is just as simple to handle as the magnetic brake; its power is great and constant, and it is entirely independent of any rotating or electrical mechanism, and is entirely separate and distinct from other apparatus and moving mechanism on the car; it brings the car to rest in much less than half the distance the magnetic brake does—in fact, in my opinion, it is very much superior in every way to the magnetic brake. If interested persons will make inquiries, I feel sure they will find out that one, if not more, of the recent accidents had cars equipped with electro-magnetic track brakes. The Hewitt & Rhodes brake has been in use over 12 months on long and steep gradients in the town of Oldham, and has prevented many an accident.

**Wm. R. Bowker.**

Halifax, *October 28th*, 1902.

---

**Mechanical Engineers for Electric Generating Stations.**

Mr. Vezey has done me the honour of referring to me in three places in his letter, but he does not yet tell me what the station superintendent finds to do. I will not trouble any more on that score; either I have been singularly fortunate in the assistants I have come across, or he and his chief engineer friend have a singular faculty for selecting "wasters" as their assistants.

I am sorry I caused Mr. Vezey to go astray by the use of the expression—routed out. It may interest him to know that the company whose works I was referring to were for at least two years the holders of the record for the United Kingdom for lowest works' costs and lowest lbs. per unit of coal and water, and I believe they are still well within the first six, though hampered by being compelled to use the most expensive Welsh coal and having no wharfage for its delivery. As regards my being an engineer, Mr. Vezey is apparently so narrow minded that he cannot allow anyone to differ from him without considering him a charlatán.

However, I am going to ask him to answer a few questions, on the ground that one who sets himself so high ought to show his credentials.

1. Does he carry out his tests and steaming trials on the ordinary load on his station, and what length of test, and what per cent. variation of load during the tests does he consider will give satisfactory results?

2. If the load is kept artificially constant, to what account does he charge the coal and water consumption?

3. What are the lowest figures he has obtained for coal and water per unit, and what was the cost per unit generated? By this I mean the year's results.

4. What was the net profit, and what per cent. of capital was put aside for depreciation? If a local authority, what is put aside for sinking fund?

This will enable me to decide:—From 1 and 2, what his tests are worth; from 2, whether he is spending someone else's money on what it was not provided for; from 3, whether his tests have enabled him to get good results in working; from 4, to what extent his employers are suffering from his proceedings.

Lastly, with due deference, whether Mr. Vezey is a suitable person to lay down the law on this subject, or whether he has become fossillised by his "great experience,"

like one or two better known men whose names occur to me, who, because they have spent the best years of their life in the central stations, think that they are authorities on all subjects of engineering.

A.I.E.E.

---

I am willing to accept Mr. Vezey's statement that his experience has not been narrow, but his views on the shift engineer question, as expressed in his recent correspondence, seem to me to approach very nearly to Euclid's definition of a "line."

Personally, I have come in contact with various specimens of his "glorified" labourer, and would sub-divide them into the following classes :—

1. The college man, with the swollen head and vacuous mind, whose capacity, mechanical or electrical, is negligible (pretensions usually electrical). He, however, is So-and-So's friend.

2. We have the "ancient mariner," who has probably greased the engines of a tramp for a period, and has for some reason taken unto himself a shore job and settled down. This is the man who, on the least sign of superior electrical knowledge by a brother shift engineer, will swear by all his gods that this other knows not a manhole cover from a crosshead.

Lastly, we have the earnest seeker after truth, who, having had a good technical training and workshop experience (mechanical, electrical, or both), had taken the post (and the miserable pittance pertaining thereto) of shift engineer in the hope of its leading to better things.

I maintain that in all but the smallest stations (and sometimes in these) this latter class greatly predominates, and that it does not greatly signify whether his experience, previous to his taking up station work, has been electrical or mechanical, for being acquainted with good electrical practice, he will make it his business to acquire the necessary mechanical knowledge, and conversely if his previous experience is mechanical he will have little difficulty in mastering the requisite electrical work—*if he be the earnest seeker*.

In my opinion this, the common type of shift engineer, is a much "put-upon" individual. He has to struggle on with his 25s., cheap oil, bad coal, and insufficient staff, while "we chief engineers" sit at the 'phone and say things—"Bad pressure." "Pay a little more attention," &c.

In conclusion, I would ask Mr. Vezey has he ever come across the chief engineer (aye, and station superintendent), who, arriving at the station half an hour after the break down has been experienced and rectified, soundly slates the poor shift man with, "Why did you do that? Why didn't you do so and so?" the probability being that had "we chief engineers" been present, their first and only move would have been towards the door. Such individuals exist, but *deo gratias*, like the incapable shift engineer, they are rare.

J. Prentice.

P.S.—I hope I am not taking an unfair advantage of Mr. Vezey, in writing after he has declared his part of the correspondence closed.

---

I have read with considerable interest recent letters in the Electrical Review on the above subject, and hope you will be able to find space for a few more remarks before finally closing the discussion.

Through the seeming ignorance of my parents, I am one of the many unfortunate individuals who started in a central station as pupil, and never went through the shops, and yet I have testimonials from central station chiefs stating that I am fully competent to take entire charge of all the machinery in and connected with the power house. Am I, then, on account of the frantic wails of Messrs. Vezey and Co. to give up my salary, position, &c., and become a burden on my parents by starting to go through the shops if such a thing be now possible? No man is fitted for the post of station superintendent unless he has first of all been a shift engineer. I suppose in years to come all of us noble army of "non-shop" martyrs will, whichever way we turn, see a spectral "Veezeyion" in his grave clothes pointing at us with the skeleton finger of scorn, and shrieking in a churchyard voice, "Ha! thou fraud, thou hast never been through the shops, jump into the Thames at once or 'touch the inner.'"

Hard Lines.

---

I am delighted to see that Mr. Vezey does not propose to write any further on the subject. I am delighted for one reason, viz., for truth's sake, for Mr. Vezey in his last letter has surely sounded the lowest note in the orchestra of absurdity.

The typical shift engineer is generally a young man who (not because he is competent, but because he will prove a convenient scapegoat if the workmen make a mistake) is made nominally head of the shift! Did anyone outside a central station ever hear such absolute humbug? Yet this is Mr. Vezey's opinion, and he has had 15 years' of experience! Mr. Vezey forgets, or does not know, that in a central station everyone is dependent on the other; but the shift engineer does not shelve the responsibility on to the drivers and firemen; how could he, in fact?

I very much admired the letter signed "A.I.E.E.," and he is perfectly correct in saying that the figures are ample for finding out any fault. Mr. Vezey apparently has some instrument like a divining rod which will tell him when a blow-down is leaking.

Mr. Vezey appears disappointed that no chief engineer has joined in this discussion. No chief engineer could, without flatly contradicting the majority of the statements made by Mr. Vezey. I do not say that all shift engineers are competent, but the majority are, and I venture to predict that if the wholesale scrapping were to take place, men of whom Mr. Vezey is a type would doubtless find their place on the heap.

A Shift Engineer.

---

### Professional Etiquette.

Though not a member of the Institution, I may be supposed entitled to comment on the new circular of the Council—or ought I to say the circular of the new Council?—seeing that it has been addressed to municipal authorities, to whom I have equal right of access with any M.I.E.E. Doubtless also a circular has been addressed to the Colonial Office, which recently perpetrated the biggest breach of the year, and received, it is said, 62 applications, representing, we may take it, nearly 200 engineers. I am told by many M.I.E.E. that the approved system of getting jobs is to live yourself, or appoint a representative to live, in a given town, to sit upon the doorstep of the municipality and pour libations to the gods, who, when reduced to saturation limit, if this be possible, will then appoint their engineer. If this has been the rule with firms of high standing and experience—experience, by the way, gained by these doubtful methods—do the Council now intend to confirm such firms in their ill-gotten standing and monopoly by barring the door upon newer aspirants to municipal fame?

An unlimited capacity for $C_2H_6O$ has become recognised as superior to technical ability.

The introduction of American methods of business and professional etiquette may have had much to do with the system of corrupt practices that prevails, but I venture to say that as regards the American Society of Civil Engineers, no engineer would be suffered to continue as a member who should be guilty of the practices notoriously common among the M.I.E.E.

Why does not the Council take the bull by the horns, and issue edicts of expulsion?

Now, all the American Societies allow their members the right of public advertising to the extent of what is called a professional card, not larger than an ordinary pasteboard, and giving simply name and class of work undertaken. (See Supplement for sample card.) The engineer who occupies merely desk room is thus placed at a better advantage in regard to big firms in front offices than he can be here, where the desk room idea is unfortunately non-existent.

But, Sir, the unfortunate impression prevails among M.I.E.E. that men who are, or have been, members of their Council (I have no list of the Institution by me, and do not know the composition of past or present Councils) are among

the worst offenders against the principles and tenets set down in the six standard rules, and it is common property that very grave suspicions are held as to breaches of Rules 5 and 6 by members of some or one of the many Institutions. Whatever may be said as to Rules 1 to 4, the breach of Rules 5 and 6 ought to be visited by expulsion. Are the Council men enough to do so? or would the expelled ones turn and rend somebody?

As regards your own strictures on what may be termed professional knobsticks, do we not laugh to scorn the habits of trades unions which mark such very funny dividing lines between what is to be done by the plumber and what by the smith; what appertains to the carpenter, the joiner or the cabinet maker. If the electrical engineer is to be so jealous of his special branch, why does he intermeddle with the architect or with the steam engineer? Electrical engineers, as a rule, make a terrible mess of steam plant. They have put things back 50 years. It is to their meddling beyond the generator spindle that we owe the entrance of the Americans into the field, who bring with them usually an ignorance of our methods and our fuels only equalled by indifference to questions of mere æsthetics. To whom do we owe it that our skies are plastered with soot if not to the electrical engineers who have let the American work his will? How many station engineers are there who realise the mess they have got into by ignorantly succumbing to boiler practices that may serve in America, but are hopeless here? You can count them on your fingers.

If the bridge builder starts in as an electrical engineer, he does employ an electrician. But the mere electrician who starts out as a power engineer, relies on mere boiler and engine touts for his power, and hence we find the modern power station is little but a sample room of heterogeneous parts, void and formless, and little better than a testimonial to the ability of a few representatives to sell anything.

My own bringing up entitled me to call myself a civil or a mechanical engineer. There was no electricity then. I have been engaged in steam railroad work, have laid tramways in the Colonies, worked them, have done some miles of electrical tramway work at home, and had the overcharge of plant of a few thousand KW., and seen all I could of other systems, yet, as a mechanical engineer, would you shut me outside the ring fence of monopoly in which you wish to guard the electrical man? Your plea is somewhat two-edged, and enables the excluded civil and mechanical men to reply. We agree to this exclusion, provided that the electrical man will keep inside the ring fence. Let him confine himself to his wires and cables, and tell us how big he has bored his armatures, and we will do the rest. We will see to it that there is an architect on the building, a civil engineer on the cooling reservoir (architects please note), a steam engineer on the engines and boilers. Why, Sir, we steam engineers would very soon rise to affluence with a tenth of the work now filched from us by electrical engineers and carried out in a manner that suggests that not an atom of thought has been given to the important chemical processes which precede, and are essential to, the production of power. These are the men whom you ask should be protected from outside competition, and who have failed to grasp the elementary principles of the work they insist on grabbing from the civils and mechanicals whom you stigmatise as rapacious intruders. I quite agree that if all the rapacious intruders were kept in bounds, a "vast amount of bad work would be avoided."

To return to the question of etiquette, let me state some facts. That they are substantially true, you, Sir, can corroborate, subject to a necessary difference in the telling of them, in order to conceal identities. A sometime member of Council of one of our engineering institutions was asked to pick out of a list of two or three names certain engineers to do certain work of investigation. One reason for asking him was that he himself was totally outside the particular work, and could therefore have no covetousness to do it himself. He was simply to arbitrate between names of men selected by two parties to the suit. The selection of one name would have given the work to a man who was in the unique position of being the only engineer in London who had any experience of the work to be done. Yet the arbiter brushed them all aside and selected his own firm, and I was informed that the report missed all the essential points, and was useless to both parties. Now, if the I.E.E. contains men like this, the Council will find it very difficult to effect reforms, when by doing so they do but confirm the worst offenders in their position and emoluments.

It is only by rooting such members out that they can enforce due obedience to the law in others. The mischief is done now. The old offenders are too well established to be shaken, and can laugh at the new man, who must sit unknown till doomsday. Will the I.E.E. guarantee employment to such when work fails? Will they make it a breach of etiquette for a landlord to demand rent? And will the big guns of the I.E.E. cease from such practices as I have detailed?

Among members of the Institution are some who, when stuck over a job they do not understand, are more willing to ask advice than to pay fees. As we all want to grind our own axe, will the Council of the Institution accept the position of judge of such breaches of etiquette?

There is so much purging to be done among its own members and associates, that the recent circular seems somewhat of a gnat in comparison with several camels.

**W. H. Booth, M.Am.Soc.C.E.**

2, Queen Anne's Gate, S.W.

---

What a pity it seems that our Institution cannot find something else to do than send out to town clerks, &c., the "Standard of Professional Etiquette" as given in your last issue.

What a blessed time it will be when we can all sit in our offices waiting for orders to come along, but I suppose the *élite* of our profession are finding that a name with a good handle before or after it does not secure the number of jobs it used to before there were so many in the field.

If the I.E.E, instead of wasting time in sending out the circular, had a conference with the Institute of British Architects, and got them to issue a circular saying that architects should not be entrusted with electrical work, it would have been of more advantage to the electrical profession generally.

I could give you, Sir, many instances of large jobs which *bonâ fide* consulting engineers have been prevented from getting by architects employed in new buildings, because "we have allowed in our scheme so much for electric lighting, and will prepare our own specifications."

The wheeze is then to send for some contractor, ask him to prepare a scheme, and he may, or may not, get the order. The supervision of the job does not seem to matter, and the client soon finds that he has an antiquated installation, or one which is a constant source of trouble and expense.

I consider the action of the Council of the I.E.E. quite uncalled for, and, although I do not believe in advertising for work, or answering advertisements, yet, in many cases, the advantages of electric lighting having been brought before a Council by a letter from a consulting engineer, has resulted in that Council coming to a decision sooner than if it had not had data placed before it.

Why did not our Council some few years ago, when the name Electricity was being dragged through the mud by a quack, conduct the prosecution, for which it could soon have raised the funds, instead of allowing this to be done by an electrical journal at its own great cost?

The days of large fees are over for preparing electric lighting schemes, because Councils will not pay these now for a name, and I consider it an insult to the profession for the Council of the I.E.E. to tell town clerks that "by employing those who seek work, they may deprive themselves of the services of electrical engineers of high standing and great experience."

It would be interesting to have a list of those consultants whom the Council of the Institution consider of "high standing," and see whether their results justify this remark.

**Young Consultant.**

---

### Students' Difficulties.

I see with great pleasure that notice has been taken of my little article on the above subject, and I must thank several writers for their kind criticism of it. I should like to say

just a few words in return, as I am afraid that one or two of my points have been missed—perhaps they were not quite clear.

Firstly, in reply to a "University Lecturer," I would say that by "student" I mean one who is at the time undergoing a regular course of instruction or training at some technical college, or in the workshops of a large firm, in fact, one who is in no position of authority, but who is actually learning the work he is doing bit by bit, and is not in receipt of any remuneration for the work he is engaged upon.

I know quite well that to the exceptional men whom a "University Lecturer" mentioned, the course of training was not of great importance. This bears out my statement that, to the exceptionally clever student, any special training is not necessary, as he will succeed under any circumstances.

The students I wrote about were the "average students," and to them it is quite necessary that the training should be the very best that experience can map out. Given two students of average ability, and put one through a good systematic course of training, and the other through a second-rate or haphazard course, and there is little doubt as to who will eventually prove the better man. If this is not so, the whole question of training is of no importance.

I think your correspondent, too, is rather hard in his condemnation of students, and assumes rather too much lack of energy on their part.

I think Mr. Trotter has caught one of my difficulties very clearly, when he talks of the true nature of the teaching not being explained to students. As a student, my experience is, that we are not taught to see what practical use the various subjects are to be to us in the future. If, at the beginning of a lecture, it was clearly explained as to what use the knowledge about to be imparted was to be to us on future occasions, a great interest would be at once aroused. It is the teaching of a subject, whether it be mathematics, chemistry, or anything else, in such a manner as to isolate it, as it were, from the rest of the subjects in the syllabus which forms the stumbling block.

Coming to the practical work, and, for simplicity, taking the one example of cable jointing, it is quite necessary for an engineer to know how it should be done properly, so as to be able to supervise the men under him. My difficulty is, however, that a student, by jointing, say, half a dozen cables, has learned all that it is necessary for him to learn. He simply wants to know how it *should be done*, and how it *should not be done;* it is not necessary for himself to become an expert cable jointer, yet the chances are that during his apprenticeship in works he is put to joint cables from month's end to month's end. This applies to practical work throughout. Unless the student is very sharp, he will never get a change of work, and then he naturally gets discontented.

In answer to a "Reader," I would say that I am, or rather was, a student in my own definition of the term when the article appeared in print. Within the last few days I have terminated my course of instruction, and have now to find out what was lacking in my past training, which I shall require in future work. A "Reader" says that a student must study hard during his *spare time* while at the works. If he keeps conscientiously to the workshop hours, he will not have much spare time. This is really another difficulty, and on account of the old adage *Mens Sana in Corpore Sano*, is not so very easy to those who have to surmount it.

**The Writer of the Article.**

---

The discussion on students' difficulties in your columns has interested me greatly, as some few years ago I took a three years' course of electrical engineering at one of our best-equipped technical colleges, after spending two years in the shops, while I have since had ample opportunity of finding out my weak points when confronted with engineering problems in my daily work.

I venture to think that, if attention could be given to the matters to which I am about to refer, those who go through a similar training would be further on the way towards being engineers at the end of it than the present-day student can hope to be.

In the first place, students ought to come much better prepared to technical colleges than they do. Unfortunately, the teaching of mathematics, physics, and chemistry in most schools still savours of the Middle Ages; but if the entrance examinations at the technical colleges were made much stiffer, the schools, or, at any rate, those boasting a science or engineering side, would have to follow suit, and raise their standard of teaching in these subjects, and we might see some approach to the common-sense methods which Prof. Perry so eloquently advocates. However, even if a boy is denied proper teaching at school, he can make up for it at evening classes while he is going through the shops. As your correspondent "Reader" points out, it is very little use going to a technical college without a works training beforehand.

It would, indeed, be a very good thing if the colleges only accepted men who had been through the shops.

Secondly, why cannot we have as professors and lecturers in all subjects only practical engineers, and not merely scientists? An engineer is often a mathematician or a chemist, but the converse is rarely the case. I can fully sympathise with "A Student's" feelings when a learned professor covers a large blackboard with a maze of symbols without deigning to explain what he is driving at, or how the results he obtains can be applied. I have sometimes taken a question that a great professor had been lecturing about for an hour, with no further result to myself than utter bewilderment, to one of his assistants who happened to be a practical engineer, and in five minutes the matter was put so clearly that I could not only understand how to obtain the result, but also see how to use it.

Finally, would not the difficulties of students and lecturers alike be much diminished if the college course were made longer? That three years are insufficient is proved by the fact that lecturers hardly ever get through their syllabuses in the allotted time. The subjects to be dealt with in the first year cannot all find place in the lectures and laboratory work of that year, and, of course, they cannot be allowed to lap over into the next year, so that some of them never get mentioned at all; and the same thing occurs in the second and third years. However well arranged and complete the syllabus may be, the lecturer can only give selections from it in the time at his disposal, and I think this accounts for much of the want of continuity apparent in technical courses. Four, or even five, years would be none too much in which to learn all that may be satisfactorily taught in a technical institution.

In conclusion, I certainly believe that a college such as I depict, with an entrance examination of a standard at least equivalent to, say, the entrance to Woolwich or Sandhurst, a staff of engineer instructors, a five years' course, and students who had all been through the shops—while it would be inaccessible to the various undesirables whom "A University Lecturer" deplores—would attract and turn out men who would be fit, before long, to be called engineers in the best sense of the term; a position to which I, and most of my late fellow-students, are still only

**On the Way.**

---

## PARLIAMENTARY.

### Tube Railway Committee.

**On 21st inst. the Select Committee of the House of Commons under the chairmanship of Sir Lewis McIver, sat to consider the London United Electric Railways Bill and the Piccadilly, City and North-East London Railway Bill. When the Committee sat before the recess, it was explained that the promoters of the two Bills had combined, and the proposal was to form a through route from Palmer's Green *vid* Tottenham, Stoke Newington, Hackney Road, Shoreditch, Monument, Ludgate Circus, the Law Courts, Charing Cross, Hyde Park Corner, Sloane Square, and on to Hammersmith. So much of the scheme as ran from Palmer's Green to Hyde Park Corner was in the original Bill of the Piccadilly, City & North-East London Railway, while the remainder of the through route was in the Bill of the London United Electric Railways. The Bill of the London United Electric Railways also provided for a branch line from Sloane Street to Clapham.**

**At the commencement of the proceedings, Sir Edward Clarke, who appeared for the London United Electric Railways Co., said he thought it was only right that he should say something on the matter, having regard to the instruction carried in the House of Commons with regard to the Bill. The instruction of the House of Commons with respect to the Bill was:—"That the Select Committee was to take security for the completion of the whole of the scheme of railways comprised in the Bill, either by making the**

rights of the undertakers under the Bill conditional upon due performance of their whole undertaking, or otherwise as the Committee may think fit." He thought that that instruction was capable of two constructions. One construction would be that the Bill of the London United Railways should not be passed unless the promoters of that Bill gave security to satisfy the Committee as to the completion of the whole scheme of railways comprised in the Bill of the London United Railways, or that the instruction involved the completion of the whole of the scheme of railways, including that part relating to the Piccadilly, City, and North-East Railway Bill. If the undertaking meant that the undertakers had to guarantee the completion of the scheme of the Piccadilly, City, and North-East London Railway, it could not be done. The two parties who had joined in proposing the scheme had not been able, and were not likely to be able, to come to an arrangement for the management of the undertaking, and so far as the promoters of the London United Electric Railways Bill were concerned, he had to say that they were not in a position to satisfy the Committee on the point when the whole scheme could be completed. If, on the other hand, the instruction of the House of Commons only applied to the part of the scheme contained in the London United Electric Railways Bill, then he had to say this. The Bill as it had been passed through the House of Lords, carried the railway from Hammersmith to Hyde Park Corner, and part of that line was through Sloane Square to Hyde Park Corner. Since the matter was before the Committee of the House of Lords, Messrs. Speyer Bros. had acquired a commanding interest in the London United Tramways Co. That firm was interested in the line which had been sanctioned by an Act which received the Royal Assent the previous day, viz., the Brompton and Piccadilly Circus line. That line contained a piece of railway from Sloane Street to Hyde Park Corner; it was a piece of line which was very expensive, and there would be no object in duplicating it, and therefore the promoters of the Electric Railways Bill would not be able to undertake to do so, and consequently they would ask for the abandonment of the piece of line contained in their Bill between Sloane Street and Hyde Park Corner. That was a matter of great importance to all parties. In the first place, if the promoters of the Bill were allowed to abandon that piece of the line, they would utilise the Brompton and Piccadilly Railway, by which a through route to that railway could be obtained, but they could not blink the fact that it would do away with a piece of line which was to give a through line from Hammersmith to the Piccadilly, City and North-East Railway line. Under those circumstances, he thought it right to make a statement to the Committee, and to say that so far as the promoters of the Bill he represented were concerned, they were not in a position to satisfy the Committee upon the point on which the instruction had been passed in the House of Commons.

Mr. Balfour Browne said he did not know anything about this matter when he came into that room. He was appearing for the Piccadilly, City and North-East London Railway. On the faith of an understanding with the London United Electric Railways Co. that the latter would make a railway from Hammersmith to Hyde Park Corner, his clients in the House of Lords withdrew that part of their Bill which would have authorised them to make their railway to Hammersmith. The two parties were absolutely at one with regard to that matter in July last. In fact, he was appearing for both the companies, and on July 28th they all knew of the instruction of the House of Commons, and he contended that his learned friend should have stated that they were not prepared to undertake that instruction at that time. Until that morning he thought he should have had the honour of opening the statement for the London United Electric Railways Co., but he had received the following letter:—"In view of the strained relations existing between my clients and the promoters of the Piccadilly and City Bill, I must ask you to kindly consider yourself as appearing solely for the promoters of the latter Bill. Perhaps the correspondence and draft agreement which you may not have seen may explain the position." He would ask the Committee to consider what the position was now. He had been taken to task by Mr. Perks at the meeting of the District Railway shareholders because he stated that he was in deadly antagonism to the District Railway, and that there was competition. Now they found that Messrs. Speyer Bros., who were the controlling interest in the District line, had obtained a commanding influence in the London United Tramways Co., and, in vulgar parlance, he found himself sold. Under those circumstances, he hoped the Committee would allow him and his clients to have a private consultation with reference to the procedure he should adopt. He took it that the London United Railways Bill was withdrawn.

Sir Edward Clarke said he had not yet withdrawn his Bill.

Mr. Balfour Browne said he would like to read his justification for thinking that the parties were friends, and he proceeded to read certain heads of an agreement which was come to between the parties last session.

Sir Edward Clarke said that Mr. Balfour Browne had complained of being unfairly treated, but on August 2nd a draft agreement was sent by his clients to Messrs. Morgan, and they absolutely declined to consider the proposals which they then made. Messrs. Morgan declined to discuss any terms for an agreement, and would make no other proposition. The matter was left in that way, and it was absolutely impossible that his clients should go on framing schemes which the other side would not even discuss.

The Chairman asked what was the date at which the strained relations came to a head.

Mr. Balfour Browne: Last night.

Sir Edward Clarke said the agreement was submitted on July 25th, and on August 2nd Mr. Gray, solicitor to Messrs. Morgan and Co., wrote the following letter to Mr. Godfray, who, with Mr. Geo. White, represented the London United Electric Railways:—"Dear Sir,—I have, as you wished, mentioned the matter of your proposed draft agreement to my clients. Sir Clinton Dawkins is leaving London in a few days, and may not be available until the middle of October, and I think it desirable that, if anything is to be done, Mr. White should see him on the subject. I have, therefore, sent the draft agreement to Sir Clinton, but I ought to add that on reporting its scheme and terms roughly to him, he and his firm absolutely declined to discuss proposals on such a basis, and I really did not feel able to press them on their consideration." There was the dismissal of the whole matter.

Mr. Balfour Browne said that as late as last night Sir Clinton Dawkins wrote to the chairman of the London United Railways Co., asking him to meet him and discuss the matter. There had been an agreement submitted which proposed that although Sir Clinton Dawkin's party were to contribute $\frac{4}{5}$ths of the capital and the other party were to contribute only $\frac{3}{5}$ths, there should be equal control. They submitted an agreement in the same form, and it was postponed until after the vacation.

Sir Edward Clarke read correspondence that on September 8th passed between Mr. Gray and Mr. Geo. White.

The Committee adjourned for a time while Mr. Balfour Browne consulted his clients, and on the resumption of the proceedings, Sir Edward Clarke said that on behalf of the promoters he formally withdrew the London United Electric Bill.

Mr. Balfour Browne said that he meant to proceed with his Bill, and he wished to go farther, and would pledge the promoters of this Bill to go in the following session of Parliament for that portion of their Bill which they had dropped owing to the agreement they came to with the London United Railways Co. The Piccadilly, City and North-East London Railway Co. originally proceeded to carry their railway from Hyde Park Corner to Hammersmith, but when they came to an agreement with the other company they dropped that portion of their Bill in the House of Lords, but now he was prepared to pledge the promoters to ask for powers to construct the completed line next session.

The Chairman said what the Committee wished to know was what portion of the whole scheme was now before them.

Mr. Balfour Browne said that the scheme now before them was for the construction of a tube railway from Tottenham to Hyde Park Corner. The other part of the combined scheme from Hyde Park Corner to Hammersmith was dropped by the withdrawal of the London United Electric Railways Co., as was also the branch route from Sloane Street to Clapham Junction.

The Chairman said that before they went into the merits of the scheme, the Committee wanted Mr. Balfour Browne to address them with regard to the instruction of the House of Commons.

Later, Mr. Balfour Browne said there was no doubt that the intention of the instruction given by the House of Commons was that the whole scheme should be carried out from Hammersmith to Tottenham in the interests of the public. Owing to the action of Sir Edward Clarke's clients, he could only give a guarantee with regard to a portion of the scheme, and, in addition, pledge his promoters to take the first opportunity of introducing a Bill in the ensuing session of Parliament to complete the line from Hyde Park Corner to Hammersmith. He thought that carried out the sense of the House of Commons instruction. Owing to the fact that certain gentlemen had got control of the tramway company, that part of the scheme from Hyde Park Corner to Hammersmith was no more. He could not resuscitate the portions of his Bill that he had dropped, but he could introduce his Bill again next session.

The Chairman said he quite saw that it was a hard case, but the Committee had certain instructions, and as Mr. Balfour Browne had admitted, the intention was to get guarantees for the construction of the complete scheme. What was offered to them now was a guarantee for a portion of the line, and an undertaking to ask Parliament next session to grant further powers to carry the line further. What Mr. Browne had to convince them was that they would be carrying out the instructions of the House of Commons if they took this in lieu of the complete guarantee.

Mr. Balfour Browne argued that under the circumstances the House of Commons would probably not enforce the instruction. He asked the Committee to consider what the result of the action was. His clients had spent thousands of pounds to bring the matter to the present stage. It had been before the Joint Committee last year, and if he withdrew his Bill now, he would have to run the gauntlet over again, and all the money would have been absolutely thrown away. He thought he could convince the Committee that this portion was a most excellent scheme, as it was. However, he must say that if the Committee looked at it absolutely technically, the undertaking did mean the whole scheme, and, of course, they could not take his security for the completion of other schemes.

Sir Ralph Littler, K.C., who appeared for the Brompton and Piccadilly Railway, contended that it was impossible to proceed with that scheme piecemeal, for if they carried the portion of the Bill brought forward by Mr. Balfour Browne, they would prejudge the case, and it would be absolutely antagonistic to the House of Commons.

Mr. Pember, who represented the Metropolitan District Railway Co., strongly objected to the Committee dealing with the matter in a piecemeal way. It would be unfair to the Metropolitan District Railway, who prepared a mass of evidence for the purpose of showing the absolute financial worthlessness of such a scheme, but such evidence would be inapplicable to part of the scheme. It would also be unfair to the Central London Railway, whose scheme was rejected by the Committee in favour of the combined scheme, and to other promoters whose Bills were rejected.

Mr. Balfour Browne said he would suggest that as the House of

Commons was strong enough not to allow the public to be jockeyed out of this through scheme, the Committee should adjourn, and should report the facts to the House of Lords that the London United Railways Bill had been withdrawn, and ask what they were to do under the circumstances.

After the Committee had deliberated in private, the Chairman said the Committee were of opinion that the scheme as it was now before them, with one half dropped, was no longer the scheme referred to in the preamble. The difficulty which the Committee found themselves in, and which they would be very glad to get over as regarded the expense and trouble to which the promoters had been put and the public gain in getting even a portion of the new lines, was that they were absolutely barred by the instruction of the House of Commons from proceeding any further with the Bill as it stood. There was no doubt as to what the intention of the House of Commons was—it was to give effect to the recommendation of the Joint Select Committee to secure through lines, and not to have piece work, and the scheme of Mr. Balfour Browne as it stood in July was most acceptable on those grounds. It seemed clear to the Committee that it was impossible for them to give effect to that instruction—the result being that they could not give the guarantees required by those instructions, and, moreover, they could not prove the preamble. The Committee therefore must find the preamble not proved, because it was not possible to prove it.

On Thursday, October 23rd, Sir L. McIver's Committee of the House of Commons again sat in connection with the Piccadilly, City and North-East Railway Bill.

The Chairman said that after the unexpected proceedings of Tuesday, owing to the sudden collapse of a scheme apparently of great public advantage, and which at all events the authorities to whom it had been submitted had blessed, the Committee adjourned in order that they might have time to consider any proposition to save the situation. As you are aware, suggestions have been made—among others your own suggestion—that you offered to pledge your clients to introduce a Bill into the next Session to take up the dropped line of the London Electric Railways, and so to complete the original through route, the Committee find that a proposition which a Commitee of the House cannot discuss. No one can say what the effect of that Bill might be, and no one could say until it is drafted what the Bill might contain. Similarly the Committee could not deal with the question advanced by the opponents of the Bill as to the extent to which the amalgamation, which is now abandoned, prejudiced the other competing schemes in the other House. Another suggestion has been made that the House of Commons shall make a special report to the House, or suspend its decision in order to allow time for an independent motion to be made in the House in respect of the Bill. Neither of these propositions commends itself to the Committee as warranted by the circumstances, or indeed by precedent. So far as the Committee is concerned, its duties seem to be simple and obvious. The Committee is of opinion in consequence of the withdrawal of the London United Electric Railways Bill that the Piccadilly, City and North-East London Railway Bill no longer represents the scheme sent up to this Committee. That this is so has been frankly admitted by the counsel. The Bill which passed through the other House, and which passed first and second reading in this House, provided in alliance with the withdrawn Bill, a complete through route from Palmer's Green by the Piccadilly and City Railway to Hammersmith, to be there linked up, by a system of through rates, with the London United Electric Tramways It contained a schedule of through and very cheap fares, and in a large measure it gave effect to the principal recommendations of the Joint Committee on London Undergr und Railways. It left the House of Commons as an amalgamated and complete scheme for a through route, and the preamble is wholly meaningless unless the proposal is for a through route. In the House of Commons it was saddled with instructions designed to emphasise the fact, and to be secured by guarantees that it should be sanctioned only as a complete and amalgamated scheme that gave a through route. The defection of the London Electric Railways renders the realisation of this scheme impossible under the Bill. That is freely admitted. The Committee has not the shadow of doubt that the meaning of the instruction and the intention of the House of Commons was to secure a complete through route, and that nothing else would be sanctioned. It is open to the House to withdraw or to modify its instruction, but until it does so, the instruction is absolutely binding on this Committee. This Committee cannot enforce that instruction of the House, because the promoters of this Bill cannot give the required guarantee, and the promoters may not begin their proof until they have given that guarantee, and on these grounds the Committee can only decide that the preamble cannot be proven. It is admitted that the guarantee cannot be given, and therefore the proving of the preamble is impossible, and as it would be absurd to put the parties to the trouble and expense of trying to prove the impossible, the Committee find the preamble of this Bill is not proven. That is the finding.

---

The House of Commons had a debate on Wednesday night (29th inst.), on the question whether the Piccadilly, City and North-East London Bill should be recommitted, and the end of it was that the matter must wait over until next session. Meanwhile the L.C.C. is proceeding to plan big things in the way of tube schemes, and some reference thereto appears on another page of this issue.

---

The Baker Street and Waterloo Railway, the Brompton and Piccadilly Circus Railway, the Charing Cross, Euston and Hampstead Railway and the North-West London Railway Bills were read a third time on October 20th.

## BUSINESS NOTES.

### Electrical Wares Exported.

| Week ending Oct. 29th, 1901. | | Week ending Oct. 28th, 1902. | |
|---|---|---|---|
| Adelaide | Value £118 | Alexandria | Value £311 |
| Bilbao | 100 | Amsterdam | 161 |
| Bombay | 85 | Auckland | 432 |
| „ Teleg. wire | 355 | Bombay | 724 |
| Boulogne | 32 | Buenos Ayres | 897 |
| Buenos Ayres | 231 | „ Teleg. cable | 1,564 |
| „ Teleg. mat. | 510 | „ Teleg. mat. | 270 |
| Calcutta | 935 | Calcutta | 450 |
| Cape Town. Teleg. mat. | 900 | Cape Town | 309 |
| Colombo | 42 | Channel Islands | 42 |
| Copenhagen. Teleg. cable | 67 | Christiania. Teleg. wire | 11 |
| Durban | 577 | Cologne | 45 |
| East London | 398 | Colombo | 42 |
| „ Teleg. poles | 189 | Durban | 3,771 |
| Fremantle | 50 | East London | 225 |
| Halifax | 10 | Flushing | 10 |
| Hobart | 47 | „ Ship's telegraph | 55 |
| Karachi | 10 | Fremantle | 34 |
| Launceston | 109 | Gibraltar | 26 |
| Melbourne | 673 | Hamburg | 105 |
| Nagasaki | 170 | Hong Kong | 150 |
| Penang | 824 | Liban | 67 |
| Port Elizabeth | 84 | Melbourne | 334 |
| Rangoon | 1,308 | Ostend | 41 |
| Rotterdam | 65 | Perth | 17 |
| St. Petersburg | 248 | Port Elizabeth | 1,284 |
| Singapore | 299 | Rotterdam. Teleg. mat. | 230 |
| Stockholm | 26 | Shanghai | 818 |
| „ Teleg. cable | 564 | Sydney | 14 |
| Sydney | 1,447 | Wellington | 1,075 |
| Tokio | 39 | | |
| Trinidad | 90 | | |
| Valparaiso | 10 | | |
| Wellington | 121 | | |
| „ Elec. instruments | 1,043 | | |
| „ Teleph. mat. | 925 | | |
| Yokohama | 283 | | |
| Total | £12,174 | Total | £13,008 |

### Foreign Goods Transhipped.

Bombay. Electrolyser .. Value £278 | New York. Elec. goods.. Value £70

**Bankruptcy Proceedings.**—At a sitting of the London Bankruptcy Court held on Wednesday last week, Fredk. H. Bowman, 39, Victoria Street, Westminster, attended before Mr. Registrar Giffard for public examination upon accounts showing total liabilities £14,123, of which £12,218 are expected to rank against assets expected to produce £1,846. Mr. C. A. Pope, Assistant Receiver, conducted the examination, and Mr. Hayes Marshall appeared for the debtor. In the course of his evidence, the debtor said he was an electrical engineer and a consulting chemist, and was the holder of a good many qualifications. In former years he was a cotton spinner at Halifax, and next a chemical manufacturer at Northwich. The latter busine s was amalgamated in 1899 with a company, and he received shares and debentures for his interest therein. Witness had acted as director of two banks, two railway companies, two insurance companies and of other undertakings. More recently he had been connected with the Chloride Electrical Storage Co., Ltd., and the Improved Electric Glow Lamp Co., Ltd., but he had resigned all offices and directorships in consequence of these proceedings. His share holding in the Chloride Electrical Storage Co., Ltd., was £600. That company called him in as an expert, and as the result of his connection with it the company had attained a very satisfactory position. The shares had a marketable value, and could only be purchased at a premium. Witness believed they would rise still higher. Asked why he had not realised them, the debtor said they were held as security by his bankers, and being in difficulties he did not think he was justified in realising them. He was also engaged as an expert in connection with the Improved Glow Lamp Co., in which he invested £800. Up to the present he had not received any fees from that company, but, he believed, it was doing very good business. Another of the companies in which he had been interested was the Oden Syndicate, which was formed to manufacture meat from grass without the intervention of the ox or sheep. In 1900 he became acquainted with Mr. Herbert Alexander, of Leeds, at whose request he became a director of the Higher Antley Brick and Tile Co. Witness financed that company, with the result that he had lost £4,689 cash actually advanced, and was liable for £5,610 upon bills which he accepted on behalf of the company. To that loss and liability he entirely attributed his failure and insolvency. Re-examined by Mr. Hayes Marshall, the debtor said he entered into the Higher Antley transactions as an investment and not as a speculation. The examination was ordered to be concluded.

**Catalogues, &c.**—We have received from the Stirling Co., of the U.S.A., a number of descriptive pamphlets and catalogues illustrating their water-tube boilers, of which we are informed over 1,300,000 H.P. have been installed. The four-drum boiler is made in standard sizes to evaporate from 3,000 to 25,000 lbs. of water per hour. The advantages of this type of boiler are fully set forth in an admirably illustrated pamphlet; another gives a series of working tests, amongst which figures an evaporation of over 13 lbs. of water per pound of combustible from and at 212° F., while a third shows the arrangement and performance of the Stirling boiler when heated with blast furnace gas.

A circular, describing the Woodward friction water-wheel governor, has been sent to us by the Woodward Governor Co., of Rockford, Illinois, U.S.A.

The Electrical Co., Ltd., of London, has issued two new electrical accessories lists. No. 7 details a variety of safety fuses, cut-outs, fuseboards and wires, ceiling roses, casing, and covers; No. 8

particularises numerous switches, wall-sockets, connecting plugs, and lampholders.

We have received an illustrated list of improved calculating rules, with slide spring and digit registering cursor, for engineers and technical purposes generally, as made at Mr. A. W. Faber's Stein factory.

Messrs. Atkinson, Schmahl & Co., sole agents for this country for Messrs. Lynen & Co., Eschweiler Works, Aix-la-Chapelle, send us a copy of their new catalogue and price list of electric light wires and cables. The catalogue is well got up and conveniently arranged, and being printed in a number of colours, is easy for reference.

The Crypto Works Co., Ltd., of 29, Clerkenwell Road, E.C., has sent us new illustrated lists of its electrical specialities, including small motors and dynamos, measuring instruments, &c.

Messrs F. Dabton & Co., of 142, St. John's Street, E.C., have issued a list of electrical novelties, such as small motors, lamps, bells, and sundries.

**"Solvo."**—The General Electric Co. (1900), Ltd., have issued a new circular, No. W. 1,018, relating to their "Solvo," a new rubber solution. The use of india-rubber solution for making electrical joints is, and will be, necessary so long as india-rubber is used for insulating cables and wires, but it is an article which becomes very expensive if it is sent about the country or shipped abroad, owing to the fact that the carriers classify it as inflammable. As a result, very high rates for carriage or freight are charged, which makes the cost of a small amount of india-rubber solution exceedingly high. The minimum cost is 5s. for carriage and 5s. for collection and delivery, which makes the total cost of 1 lb. come out at about 12s. To overcome this difficulty the company are now putting on the market this specially prepared dry form of india-rubber, for which they have registered the trade mark "Solvo." Being in a dry condition, and containing no naphtha, it can be carried at the ordinary rates. All that is necessary for the user to do is to fill up the tin of "Solvo" with coal-tar naphtha, which can be obtained cheaply anywhere. The tin of "Solvo" contains such a quantity of this substance that, when the coal-tar naphtha is added, the weight of india-rubber solution indicated on the tin will be formed by simply stirring and leaving 24 hours. This substance will, it is considered, be a boon to the electric wiring trade.

**Trade Announcements.**—Messrs. Atkinson, Schmahl and Co., of Newcastle-on-Tyne, inform us that they have concluded arrangements with Messrs. Lynen & Co., of Eschweiler Works, Aix-la-Chapelle, to represent them exclusively for Great Britain and the Colonies. Large stocks are now kept at Newcastle, Manchester and London where Messrs. Monte Callow & Co. have the sub-agency. No attempt will be made to obtain business by cutting prices, but by quality alone. Messrs. Lynen & Co. draw their own wire and manufacture their own rubber; the factory is under the management of an English engineer who has been engaged with two of the leading cable firms in England for over 15 years. English machinery and methods are used throughout the factory, which is practically electrically-driven throughout. Every endeavour has been, and will be, made to keep the goods up to the highest standard. Samples of 600 and 2,500-megohm grade have been submitted to us and these are mechanically well made and of satisfactory appearance, the wire stripping perfectly clean and the rubber being of excellent quality.

Mr. Archibald Campbell, of 28, Gray's Inn Road, W.C., is removing on November 1st to 27, Chancery Lane, W.C., where greater accommodation will ensure more prompt delivery. He is making a speciality of electroliers, brackets, standards, &c.

We are informed that the Stirling Co., of the U.S.A., have opened a British branch for the sale of the Stirling type of water-tube boilers, of which they claim to be the original manufacturers, at 53, Deansgate Arcade, Manchester.

The Siemens Electric Appliances, Ltd., of 61 and 62, Watling Street, Queen Victoria Street, E.C., has been formed for the purpose of supplying articles manufactured by Messrs. Siemens Bros. & Co., Ltd., of London, and Messrs. Siemens & Halske, of Berlin, and that Messrs. Oscar Krupka and Hermann Jacoby, of the firm of Messrs. Krupka & Jacoby, of 61 and 62, Watling Street, E.C., have been appointed managers of the company.

Messrs. Krupka & Jacoby announce that they will continue their firm of "Krupka & Jacoby" as hitherto for the sale of the manufactures of Dr. Albert Lessing, of Nurnberg, at the above address.

**Dissolutions and Liquidations.**—A petition for winding up the Electric Railways Co., Ltd., is to be heard in London on November 4th.

The petition of E. N. B. Donisthorpe and another for the winding up of the Electromotion Corporation, Ltd., was down for hearing in the Companies' Winding-up Court before Mr. Justice Byrne on Friday, October 31st. Mr. Hart appeared for the petitioners, creditors for £128 5s. He said the peculiarity about the petition was that the petitioners' debt was for rent of office and salary for secretarial services and money paid. There was nobody in England, as far as he could ascertain, whom he could serve, and really the secretary who represented the company, and who was the petitioner, had no one else to serve but himself, and he effected service at the registered office of the company in the usual way. He thought that was a technically correct service. Mr. Justice Byrne said he had better endeavour to serve some shareholder. Mr. Hart thought that, as there were no directors in this country, the best way would be to put an end to the company. Mr. Justice Byrne made an order for substituted service, and directed the petition to stand over for a fortnight.

A petition was also presented by De Grelle, Houdret & Co. and others for the winding up of Electric Lighting Boards, Ltd. Mr. T. Terrell, K.C., who appeared for the petitioning creditors, asked that the petition might stand over for a week, and there being no opposition on the part of the company, Mr. Justice Byrne acceded to the application.

**Electrical Engineer's Claim.**—At the Leicester County Court on Thursday last week, John Shaw Barnes, electrical engineer, of Alfreton, brought an action against Messrs. Lea and Warren, electrical engineers, King Street, Leicester, to recover £32 10s. for 13 weeks' wages in lieu of notice. Defendants counterclaimed for £22, the chief item of which was £12 10s., part loss on a switchboard for the Ordnance Survey Works, Southampton, which defendants were under a contract to make and supply, but which it was contended plaintiff bungled. Plaintiff stated that on the Sunday morning following an interview with Mr. Lea regarding the switchboard he received a letter from the firm intimating that his services were no longer required and offering a week's wages. When he attended defendants' place the following day he was unable to gain admittance. Under an agreement he was entitled to receive three months' notice. Defendants contended that they were justified in summarily dismissing the plaintiff, and called evidence supporting this view. The judge, while agreeing that there was plenty of ground for dissatisfaction with plaintiff's conduct, did not think the circumstances justified summary dismissal, and on that ground he found for plaintiff for £24 10s., and for defendants on the counter-claim for £12, loss sustained over the switchboard, and £3 10s., moneys for which plaintiff had not properly accounted.

**Workmen's Compensation Act.**—At Norwich County Court on October 22nd, Messrs. Laurence & Scott, electrical engineers, of Norwich, asked Judge Willis, K.C., to review an award made under the Workmen's Compensation Act to an apprentice in their employ. The apprentice, at the time of the accident, was earning on the average 4s. 1d. per week, and it was agreed to pay him 2s. 1d. per week while he was incapacitated. He returned to work on February 10th last, and was able to perform his work and to earn 5s. a week. The Judge reduced the order to 1d. per week, with liberty to apply again if the circumstances changed. Costs were not allowed.

**Constructional Steel Work.**—Messrs. Redpath, Brown and Co., Ltd., Edinburgh, Glasgow and London, have recently secured the contract for the supply of the steel work which forms an important part in the construction of the new buildings to be erected for the Governors of the Glasgow and West of Scotland Technical College. The architect, Mr. David Barclay, Glasgow, in the steel construction scheme, has applied the most modern principles, mild steel to the extent of over 2,000 tons being employed. The above firm has also secured the contract for the new electrical works of Messrs. D. Bruce Peebles & Co., Leith. About 900 tons of steelwork is required for these buildings, which cover an area of about 73,200 sq. ft.

**Incandescent Lamp Combine.**—It is reported by the *Neue Freie Presse* that a scheme is being promoted for the formation of an international trust of incandescent lamp makers in Germany, Austria-Hungary, Holland and Switzerland. The proposal has emanated from the German companies, which are negotiating with the makers in the other countries mentioned, and in the event of the scheme being carried into effect, it is probable that the price of the lamps imported into the United Kingdom will be increased.—*Financial Times.*

**Superheating.**—In addition to the large number of Schmidt plants already mentioned as being on order, Messrs. Easton and Co., Ltd., are now supplying Bolton patent downtake superheaters to Messrs. Spencer & Co., Ltd., of Melksham; Messrs. E. Heaton & Son, of Manchester, for the Stretford U.D.C., Mr. C. H. Wordingham being the consulting engineer; Messrs. Olive Bros., of Bury; Messrs. The Crompton Co-operative Society of Shaw, near Oldham; and Messrs. Adamsons, of Dukinfield, for Messrs. Harrisons, of Hanley.

**The 1903 Fire Exhibition (Electrical Section).**—The Electrical Section at the forthcoming Fire Exhibition at Earl's Court will comprise primarily fire-calls and fire-alarms, but will at the same time include exhibits of systems of insulation, cut-outs and other protective devices. In fact, electrical work will have an important place accorded to it in the programme of the Exhibition. Mr. Swinburne, President of the Institution of Electrical Engineers, has accepted the chairmanship of this group, of which the deputy-chairman is Mr. Lionel Langridge, of the Royal Insurance Co., whose name has long been associated with the question of electrical risks in insurance. Among the members of the Advisory Council, there are also to be found the names of Sir W. H. Preece and Prof. Ayrton.

The Duke of Cambridge has consented to be the president of the Hon. Advisory Council of the impending International Fire Exhibition which is being organised at Earl's Court under the auspices of the British Fire Prevention Committee.

**British Insulated and Helsby Cables, Ltd.**—A circular dated Prescot, October 1st, has been sent out by the secretary, stating that the amalgamation of "The British Insulated Wire Co., Ltd.," and "The Telegraph Manufacturing Co., Ltd.," is now completed, and "it has been formally decided by special resolution of the shareholders that the title of the joint companies shall, in future, be British Insulated and Helsby Cables, Ltd."

**The Gummi-Werke "Elbe," Ltd.**—We are informed that, under the ægis of the Commerce and Discount Bank, a Hamburg Association has bought up the greater part of the shares

of the Gummi-Werke "Albe," Actien-Gesellschaft. It will be remembered that this company was founded by the recently bankrupt Leipziger Bank, and so long as the majority of the shares were held by the said bank, the prosperity of the company was rendered impossible. Under the new management, however, the company, which is now possessed of considerable means, and which has several big orders to execute, is expected to show good results in a very short time.

**Books Received.**—"Science Abstracts," October 25th. London: The Feilden Publishing Co., Ltd. 2s.

"A New System of Heavy Goods Transport on Common Roads," by B. J. Diplock. London: Longmans, Green & Co., 1902. 6s. 6d. net.

"Thirteenth Annual Volume and Lectures and Experiments of the Institute of Marine Engineers, 1901-02." Stratford: The Institute, 1902.

"Elementary Manual of Applied Mechanics," by A. Jamieson. Fifth Edition. London: Chas. Griffin & Co. 1902. 3s. 6d.

"Elementary Manual on Steam and the Steam Engine," by A. Jamieson. Ninth Edition. London: Chas. Griffin & Co. 1902. 3s. 6d.

**Fire.**—The electric lighting offices at Bromley (Kent), were destroyed by fire on Friday. The fire broke out on premises occupied by the Autocar Co., Ltd., West Street, and spread to the electric lighting offices. The damage is covered by insurance.

**Electrical Trades Union.**—A new branch of this Union will be officially opened on Monday next, November 3rd, at Collins's Coffee Tavern, 135, Redcliff Street, Bristol.

## ELECTRIC LIGHT AND POWER NOTES.

**Bedwellty.**—The U.D.C. has decided to appoint an engineer to report on the electric lighting scheme, and to proceed with the application for a prov. order.

**Caerphilly.**—The U.D.C. has decided to apply for a prov. order, and to take supply in bulk from the South Wales E.P.D. Co.

**Camborne.**—The U.D.C. has decided to furnish the Electric Supply Co. with the necessary particulars, in order that the company may quote for public lighting by electricity.

**Chichester.**—At the meeting of the T.C. on Friday, an agreement for the transfer of the E.L. order to the Sussex Electrical Power Distribution Co., Ltd., was entered into. The company undertakes to repay the cost of obtaining the prov. order.

At the same meeting notices were received from the United Electric Light and Power Co, and the Provincial Electric Supply and Traction Co. of their intentions to apply for prov. orders for supplying within the city.

**Cowes.**—The U.D.C. has decided to oppose the proposals made by the Isle of Wight Electric Light and Power Co., Ltd., and now before the B. of T.

**Darlington.**—No opposition was offered at the L.G.B. inquiry on Thursday into the application of the T.C. for permission to raise a loan of £14,500 for the purpose of extending the electric lighting works.

**Dartford.**—The R.D.C. proposes to apply to the B. of T. for a prov. order to supply electricity to parishes within the district.

**Dundee.**—Two manhole explosions occurred on the electric supply system last week.

**Eccles.**—It has been ascertained that several interruptions in the electric lighting of the town were partly due to the cable having been pierced by the Salford Corporation gas employés and by the tramway workmen driving their picks through the cables. To repair the damage, three 50-ft. lengths of cable have had to be renewed, and the cost has been met by the Salford Gas and Tramway Departments.

**Elland.**—The Corporation Electricity Committee has fixed the price for energy for lighting at 4d. per unit, and for power purposes at 2d.

**Enniscorthy.**—The Asylum Board has resolved to ask the County Council to purchase Kilcarberry Mills for a generating station, and to equip the asylum with electric lighting, at a cost of £6,500.

**Fleetwood.**—As a result of a special test of 27 electric lamps, it has been found that the pressure supplied to six lamps is below the limit allowed by the B. of T. The U.D.C. has called the attention of the resident engineer of the electric lighting syndicate to the matter.

**Freshwater.**—The B. of T. has informed the Isle of Wight R.D.C. that it has called upon the undertakers of the E.L. order for Freshwater to commence the work forthwith or to relinquish the order. This illustrates the difference between the liberty allowed to a company and the license granted to a municipality.

**Hythe.**—The T.C. has granted powers to the Folkestone Electricity Co. to supply electricity, and the laying of mains will be commenced early in the New Year.

**Kent.**—The cost of opposing the Bill of the Kent Electric Light Co. by the various public bodies in the county amounted to £326 17s. 6d. This has been apportioned between the opposing T.Cs. and U.D.Cs.

**King's Lynn.**—The T.C. intends applying to the L.G.B. for a loan of £10,000 for extensions of the electric lighting undertaking.

**London.**—The South London Electric Supply Corporation, Ltd., reports having sold during the first nine months of the current year 645,000 units as against 535,000 units for the corresponding period of last year, showing a gross revenue of £13,436 as against £11,037, while the cost per unit sold has been reduced 25 per cent.

Bethnal Green.—The B. of T. has deferred the revocation of the M.B.C.'s prov. order for one year.

**Manchester.**—The Electricity Committee has recommended the T.C. to apply to the L.G.B. for permission to raise a loan of £10,000 for electricity purposes.

**Morecambe.**—Some stir has been aroused by rumours of mismanagement of the electricity undertaking. It appears that the arc lighting cables require renewal for the third time in four years, and six three-core pilot cables have broken down.

**Newark.**—At the meeting of the T.C. on Monday the E.L. Committee reported that it had settled the draft agreement with the Notts and Derby Electric Power Co. for the supply of energy to the borough. The question of delegating the Corporation's electric lighting powers to the company, or proceeding with its own scheme prepared by Mr. Vesey Brown, is to be considered at a special meeting to-day.

**Newton Abbot.**—The U.D.C. contemplates lighting the streets by electricity, and has asked the Urban Electric Supply Co., Ltd., to quote for 20 arc lamps (with two incandescents to each), 196 all-night lamps, and 58 half-night lamps.

**Northfleet.**—The U.D.C., which has been negotiating with the Kent Power Syndicate for the transfer of its E.L. Order, has decided to ask Gravesend T.C. if the Corporation is prepared to tender for the transfer of the Order.

**Portsmouth.**—Mr. E. Price, superintendent of the Corporation electricity works, has made a report, in which, pointing out that they would have a considerable addition to their load when the Naval Barracks were connected, while they expected other large Government establishments to come to them within, say, 12 months, he expressed the opinion that two sets of 500 KW. each should be at work 12 months hence. Considering the delays that occur, first in obtaining sanction to borrow the money, and then in procuring the plant, he thought application should be made to the L.G.B. for their sanction. He reported strongly in favour of turbines. Mr. Price's estimates were as follows:—Two turbine sets, with separate condensers and air-pumps, circulating pumps, separately driven by motors, cast-iron and steel piping, foundations, and cables to main board, complete, £11,726; one set of spares for turbines, £900; pumping station at end of intakes, brick building, with tank over, three motor-driven centrifugal pumps, with pipes and valves, £1,705. One Ferranti switchboard, nine panels, each panel of 600 KW. capacity, with ammeter fuses and oil-break switches, £1,100. Chimney, 8 ft. flue, 8 ft. fan driven by 50 H.P. compound engine with all necessary pipes, &c., £1,534. Sixty yds. of cable trench with draw box at angle, £135—£17,100. The year ended March last has (Mr. Price reports) been a profitable one for the undertaking. The extra revenue from private lighting was £4,000, as compared with an increase of £2,800 in the previous year. While the income has increased, the total expenditure on revenue account, instead of increasing with the increased output, has actually slightly decreased, owing to cheaper coal.

**Rugby.**—The E.L. Committee has recommended the U.D.C. to adopt Mr. Trentham's revised estimate of £12,000 for electric lighting purposes, and to obtain borrowing powers.

**St. Helens (I.W.).**—As a result of further negotiations, the Isle of Wight Electric Light Co. has reduced its terms to the U.D.C. for public lighting to £2 7s. 6d. per lamp. The gas company, which is competing with electric light, has also reduced its price, to £2 9s. 3d. per lamp.

**Scunthorpe.**—The U.D.C. on Friday decided to apply to the B. of T. for a prov. order to supply electricity for all purposes within the district.

**Sittingbourne.**—Two companies have notified the U.D.C. of their intentions to apply for prov. orders to supply the town. The Council will not retard the installation of electricity, but will simply confine its attention to protecting its own interests.

**South Wales.**—The engineers of the South Wales Electrical Power Distribution Co. last week made a final survey of the site of their Monmouthshire generating station, and work is to be begun at once on the buildings. Within six months from now, electrical energy will be available for the factories and collieries in the district. The works, which will eventually be one of the three large permanent stations of the Power Co., will be erected with a

comparatively small amount of plant to start with, but are so designed as to admit of rapid and easy extension. They will later on serve an area of about 350 square miles.

The company is about to proceed at once with the erection of several sub-stations for the supply of electrical energy; these will be equipped as generating stations in the first instance, the only difference between them and the permanent generating stations being in the horse-power installed. Their boilers and engines will later on be absorbed into the permanent equipment of the larger stations, and replaced by transforming apparatus in the sub-stations. By this means it will be possible to commence supply to the adjoining districts without loss of time.

**Swinton and Pendlebury.**—The B. of T. has granted the U.D.C. an extension of time in which to carry out the terms of the prov. order for electric lighting granted three years ago.

**Sydney.**—Work on the city electric lighting scheme is to be begun at once, and Mr. T. Rooke, who was nominated by Messrs. Preece & Cardew to supervise the erection of the plant, has been appointed resident engineer at a salary of £600 per annum.

**Tottenham.**—The Electricity Committee of the U.D.C. has agreed that the preparation and carrying-out of a scheme under the Council's electric lighting order shall be entrusted to the Council's engineer and an expert electrical engineer. Having heard from three firms as to the terms on which they would be prepared to act in conjunction with the Council's engineer, the Committee has decided to recommend the appointment of Mr. W. C. C. Hawtayne, his charges being 5 per cent. commission on contract for machinery, plant, mains, &c., together with disbursements, and 2½ per cent. on buildings. The report will be considered at the next Council meeting.

**Yeovil.**—The T.C. is recommended to apply during the present session of Parliament for a prov. order to supply electricity within the borough.

## ELECTRIC TRACTION NOTES.

**Altrincham District.**—The scheme (referred to in a previous issue) which is being promoted by the British Electric Traction Co. for providing a system of tramways for the district comprising Altrincham, Sale and Northenden, is being eagerly discussed locally. Public opinion is distinctly favourable to it, but the District Councils are not giving it a whole-hearted support. Some incline to the view that a joint board would be preferable to a private company; and one at least seems unable to make up its mind any way. This diversity of opinion amongst those who might be expected to consider what is best for the travelling public is not likely to deter the promoters of the scheme from proceeding with their Bill in the next session of Parliament. The Altrincham District Council, which represents the most considerable urban population, has given a pledge that before committing itself finally to any action the ratepayers shall be consulted. Meanwhile it has expressed its views in the following resolution:—"This Council approves generally of a tramway scheme from Stretford to Altrincham and through its district to Sale Station, or as near thereto as practicable, and urges the other Councils concerned to agree to an application being made for a joint provisional order for the establishment of the same." This resolution, if adhered to, may jeopardise the scheme of the Electric Traction Co., so far as the next session of Parliament is concerned. In all the negotiations that are taking place locally the promoters are represented by Mr. T. S. Turnbull, solicitor, of Manchester. The scheme, as submitted by him to the local authorities, is an eminently practical one. The idea is to construct a line from the terminus of the existing tramway in Stretford to Sale, by way of Altrincham, with a branch from Sale to Withington (where a junction would be formed with the Withington and Manchester system) by way of Northenden; also to connect with a branch from Fallowfield by Wilbraham Road, through Chorlton, to join the main line at Stretford. It is intended to ask for running powers from Withington, and also from Stretford to Manchester, over the lines belonging to, or leased by, the Manchester Corporation. The position of Sale in this matter—although its District Council in September expressed a general approval of the scheme presented by Mr. Turnbull—is, to say the least, ambiguous. The Council has, our correspondent learns incidentally, been approached by the Manchester Corporation, and the Altrincham Council likewise, but with what object is not precisely known, so that the ultimate issue is in suspense. Manchester has already huge engagements, and it is difficult to see how it can compete with a private company in working tramway lines for the advantage and benefit of the public 8 or 10 miles beyond its own boundary.

**Ashton-on-Mersey.**—The U.D.C. has decided to take a vote on the question of providing electric tramways for the town. Three different bodies have approached the Council on the subject, and the Manchester T.C. has offered to extend its system from Stretford to Ashton.

**Birkdale.**—A deputation from the U.D.C. waited on the Board of Trade in London on Monday, and asked permission to open the electric tramline from the Crown Hotel, Birkdale, to the Aughton Road level crossing at once instead of waiting an indefinite period for the completion of the line across the railway.

**Bradford.**—The Committee has made arrangements for a trial of the Bellamy canopy-top for electric tramcars.

**Bray.**—Last week the Judicial Committee of the Privy Council, sitting at Dublin Castle, considered the proposed electric tramway scheme of the General Electric Co., of Ireland. At present the railway company runs 15 trains through Bray Station per day, but the electric cars would run every quarter of an hour in summer and every half-hour in winter. Mr. Frank Maguire is a director of the company. The Lord Chancellor, who presided, announced that the Committee would report conditionally in favour of the tramways, but the further hearing will be adjourned for some months to enable the promoters to satisfy the Committee as to their financial position and arrangements.

**Bridlington and Flamborough.**—It is stated that the Flamborough to Bridlington light railway scheme will not now be proceeded with, and that a further extension of the 1897 order will not be applied for. The T.C. has opposed the scheme from the beginning. Another scheme, combining electric lighting with traction, is now being prepared.

**Bolton.**—At the Tramways Committee meeting last week it was reported that the car receipts from April 1st up to date were £47,617, which gave an increase of £2,967 over the same period last year. The Committee decided to place a roof covering on one of the electric cars by way of experiment.

**Bournemouth.**—The B.E.T. Co. recently notified the Tramways Committee of its intention to break up the roads for the construction of the Christchurch—Bournemouth tramways.

The second line of conduit tramway near the Hotel Metropole was to be commenced some days ago, and the whole of the work is to be completed through to the County Gates in five weeks from that date.

**Buenos Ayres.**—A financial contemporary learns that the scheme to build a narrow-gauge electric railway from Rosario to Bahia Blanca has been approved by the Argentine Congress.

**Cardiff.**—The Tramways Committee proposes to apply for a provisional order for nine additional sections of tramways, so that there may be a complete and connected service.

**Colchester.**—It is stated that the Council has adopted a £70,000 electric tramway scheme.

**Corea.**—An electric tramway constructed at Seoul in 1898 and opened in 1899, was, owing to an accident to a child, destroyed by the Coreans, and the power station could only be protected by the intervention of the military. Later on in the course of the same year the line was reopened, and is now in satisfactory working order. The station contained at the time of its inauguration a generator of 75 KW.; the line—a single one—is 14 kilometres long, and the carriages run at intervals of 12 minutes. In addition to the passenger service, a goods traffic is also catered for. In 1900 the power station was reconstructed to furnish light and power at the same time. It now comprises two machines of 200 H.P., actioning two double-current generators of 120 KW. The continuous current, with which the tramway is supplied, is at 550 volts, and the diphase alternating current at 385 volts. It is raised to 2,000 volts for transmission to various parts of the town and then reduced to 100 volts for distribution.

**Crystal Palace.**—At the meeting of the Crystal Palace Co., Mr. Ernest Schenk, the chairman, referred to the want of further facilities to enable the public to visit the Palace. No suburban centre in the London area was so badly in need of tramway communication as the Crystal Palace, and nowhere would such an immediate and profitable return be as certain. It was often forgotten that a number of tram lines ran to within a mile or two of the Palace from all directions, but having been made years ago for horse traction, it was not then considered feasible to mount the hill by which the Palace must be approached on all sides. That those gradients presented no difficulty whatever to electric traction, was shown by the fact that the company working the Croydon electric tramways, had this year obtained Parliamentary sanction for an extension of their system almost to the doors of the Palace at the top of Anerley Hill. Valuable as that connection undoubtedly was, those which must in the near future be made on the London side with the various tramway routes of South London, would be infinitely more important in the volume of traffic which they would bring to the Palace. The very routes by which they hoped to get tramway connection, were constructed by the Crystal Palace Co. in earlier days at its own cost, and dedicated free to the public. To quote the Act they were built "for the purpose of obtaining better access to London," and it would be grossly unfair that they should not be given the same facilities which they saw in such successful operation in other parts of London, and almost universally in the provinces and abroad.

**Dewsbury.**—The dispute between the Dewsbury Corporation and the British Electric Traction Co. in regard to the laying of a line round a curve at what is known as the Old Anchor corner has stopped the work for many weeks, and there is some probability that the Board of Trade will have to intervene.

**G. N. and City Railway.**—The Brush Electrical Engineering Co. despatched from their Falcon Works, at Loughborough, Leicestershire, on Sunday, by the Midland Railway, seven motor coaches, being the first instalment of an order for over 50 coaches for the Great Northern and City Railway. Each carriage is of the saloon type and has an overall length of 50 ft. The exterior of the cars is furnished in solid teak with the natural wood colours brought out by scientific methods of French polishing and finishing. The interiors are furnished in solid mahogany and trimmed with finely beaded and inlaid mouldings of most intricate design. All the furniture is of highly polished brass, and the seats are of the best supple rattan on long movement helical springs. Each car seats 73 passengers, and the approximate cost of each is about £1,000.

**Halifax.**—The Salterhebble lift scheme has excited so keen a controversy that the Council has decided to submit the matter to the direct judgment of the ratepayers.

**Harrogate.**—The T.C. has decided to promote a tramways Bill. The object, it is stated, is to keep out the B.E.T. Co.

**Kendal.**—The T.C. has decided not to entertain the offer of the Electric Haulage Co. to construct, free of cost, a track a mile in length, and run an electric omnibus on the overhead system for six months on trial, the Council to supply the current at 2d. per unit, and have the option of purchase at the end of the trial period.

**Italy.**—The provincial authorities have approved of the project to construct an electric railway between Bergamo and S. Giovanni Bianco, in the Brembana Valley, and have granted a subvention of £12,000 towards the construction.

**Lancaster.**—The Corporation is inviting a London firm of valuers to inspect the Lancaster to Morecambe horse tramway, with a view to purchase. The company is asking 20s. for preference shares, and 18s. for ordinary shares, although no dividends have been paid for some years to the latter. It received a better offer than this from the B.E.T. Co., but the Corporation refused to consent to the purchase.

**Leicester.**—The T.C. has received notice of an application to incorporate a company to lay down light railways between Leicester, Anstey, Groby, and Newtown Linford.

**London.**—The Light Railway Commissioners sat at Slough on 22nd inst. to consider the application of the London United Tramways Co. to extend its system from Hounslow along the Great Bath Road to Colinbrook and Slough. After a good deal of evidence had been given, Mr. Lloyd submitted that the lines would compete with the Great Western Railway. The Commissioners retired to consider the point, and on their return the Earl of Jersey announced they had come to the conclusion that there was competition, and that therefore the promoters must apply to Parliament.

L.C.C.—At Tuesday's meeting of the Council, the Parliamentary Committee, in reporting on the failure of the proposed railways between Hammersmith, the City and the north-east of London, expressed regret that the session should have passed without any addition to the means of locomotion in the direction indicated by the Joint Committee of 1901. In the opinion of the Committee the question had become of such importance that the Council should at once address itself to the problem of seeking some means by which to secure that the needs of the travelling public should be adequately met, and they therefore recommended that the Parliamentary, the Highways and the Finance Committees should be instructed to at once consider the advisability of the Council promoting in the next session a Bill on the subject of underground railways in London. Mr. J. A. Shepheard, who moved the adoption of the recommendation, said that the Committee were not asking the Council to commit itself to constructing underground railways. All the Committee required was an instruction to consider the advisability of legislation either of that kind or another form, as, for instance, co-operating with the companies or purchasing their lines on a certain day. If the railways were built by the County Council they would be worked not for profit, but for the public good, and they could be constructed at a capital cost of 3½ per cent., as compared with 6½ per cent. in the case of companies. The Committee had some reason for thinking that Parliament would now deal with the Council, and listen to anything which it might put forward.

Mr. S. Low, as an addition to the recommendation, proposed that the Committee should consider the question of urging the Government to appoint a Royal Commission or Select Committee to inquire into the whole subject of underground locomotion. Mr. Phillimore seconded the rider, which, after further discussion, was defeated by a large majority. Mr. W. H. Dickinson expressed the opinion that the only alternative was for the County Council to submit a scheme. Mr. W. M. Beachcroft remarked that if the proposal was for the Council to revive the London United scheme, it would not be a very prudent course to adopt. After further discussion, the recommendation was carried by 70 votes to 13.

*Training of Motormen.*—The Highways Committee submitted a report in relation to the proposed training of drivers for the cars to run between Westminster and Tooting. It is intended to utilise for the purpose one of the electric cars already supplied and now at the Streatham cable depôt, and the power required for driving the car is to be obtained by placing at the depôt one of the three exciter sets which have been ordered for the generating station at Greenwich, but which, although ready for delivery, will not be required until the station is completed. Some temporary alterations will have to be made to the machine, in order that the proper pressure may be obtained, but these can be effected within a short time, and at a comparatively small cost; and, as the machine will be used for the training of car drivers, the cost of the alterations may properly be defrayed out of the amount provided in the car contract for contingencies. It is also proposed, as has been done by other public bodies in similar circumstances, to give preference to the drivers now in the Council's service, as it has been found that the ordinary horse-drivers have as a rule, after proper instruction, become very good motormen for electrical cars. About 250 men will be required as motormen; and with the object of giving the men now in the Council's service full opportunity of learning to discharge properly the duties which will devolve upon them as motormen, it is proposed to establish a training school at the Streatham depôt, so soon as the exciter-set above referred to can be placed in position and be ready for working, which will be within about a month from this date. About 12 days' instruction will probably be sufficient to enable an intelligent horse-driver to learn what will be required of him as a motorman; and the school is to be opened daily, under the superintendence of two competent instructors. It is necessary for the Council to fix the rate of pay for these instructors; and persons suitable for the position would be available at a rate not exceeding £4 per week. The consideration was postponed on a recommendation in favour of proposals to this effect being sanctioned.

The L.C.C. the Finance Committee has prepared a report on the financial aspect of the proposal to construct a tramway from the present terminus in Westminster Bridge Road, *vid* Westminster Bridge, Victoria Embankment, and the portion of the subway authorised between the Strand and the Embankment. The total estimated cost of the scheme as a whole is £449,050. This sum is made up as follows:—Subway: Property, £70,000; construction of subway, £209,000. Tramway: Already authorised, from Theobald's Road to a point where the subway will pass under the Strand, £13,200; from this point to and over Westminster Bridge, £51,500; street widening at Southampton Row, £27,350; cars and car-sheds, £78,000. Total, £449,050. This capital outlay will involve an annual charge of interest and sinking fund of about £25,000 a year, decreasing as the debt is paid off. The Finance Committee state that they agree with the Highways Committee that the line is one which should be constructed, and that ultimately, if not at first, it is likely to prove remunerative.

**London and South-Western Railway and Electric Traction.**—During the consideration by a Parliamentary Committee a few months ago of a Bill which sought authority to construct various electric tramways in Surrey and Middlesex, it was made perfectly plain on behalf of the London and South-Western Railway Co.—which appeared in opposition to the scheme—that the company intend, at some future period, to proceed with the conversion to electric traction of portions of their railway system within the vicinity of London. We believe this particular railway have already suffered from the competition of existing electric tramways, and their opposition to the new proposals, although unsuccessful, was only natural under the circumstances. Since then Mr. J. W. Jacomb Hood, chief engineer to the railway, has elaborated a scheme which he suggests may be worked out some day and lead to practical results. The project consists in the electrical equipment of about 70 miles of line between Waterloo Station and Hampton Court and Twickenham, &c., and the establishment of three generating stations of a total of 7,000 H.P. for the purpose of supplying the power for the operation of the trains. Each train is to be composed of three motor cars, carrying a total of 180 passengers, and running at frequent intervals, the train mileage being calculated at 5,000,000 per annum, as compared with 1,500,000 miles yearly with the existing steam trains. It is estimated that the capital expenditure would amount to £630,000, and that in consequence of the considerably greater train mileage which would be obtained, additional traffic to the extent of £53,700 per annum would be required to meet the expenses. The chief engineer is hopeful that the earning capacity would exceed this sum, although he is careful not to express a definite opinion on the matter. As it stands, the proposal is merely a paper scheme which has not yet been adopted by the company, but the experience already gained by the line owing to the competition of electric tramways should cause the company to give serious consideration to the question of substituting electric traction for steam locomotives on the suburban lines before a further diversion of passenger traffic takes place.—*Mechanical World.*

**L. and Y. Railway Electrification.**—For the Liverpool—Southport line which the directors of the Lancashire and Yorkshire Railway have decided to electrify, the third-rail system is to be used, with direct current at 600 volts. A main generating station and sub-stations are to be erected. Motor coaches and trailers will be employed. The line is about 18¼ miles long, and is almost on an unbroken level, lying for about one-third of the distance from the Southport end, on the sea sand which forms the surface of the land over a considerable area in the locality. There are at present 14 stations between the Exchange Station, Liverpool, and the station at Southport; 76 trains per week-day now leave Liverpool for stations on the line, 40 of the trains going to Southport. The return service is equally good; 25 minutes is the time by the best trains either way at present, but this, it is expected, will be materially reduced with the new service. A good deal of the work of adapting the line and providing the new rolling stock will be done by the railway company at, or from, their works at Horwich. Some substantial contracts will, however, be placed with outside companies.

*(Continued on page 747.)*

## MANCHESTER SCHOOL OF TECHNOLOGY.

The Municipal School of Technology, at Manchester, the erection and equipment of which has occupied seven years, is now completed, and the formal opening, as mentioned in our last issue, took place on Wednesday (October 15th). The school is a direct outcome of the old Mechanics' Institution, which, for a period of nearly 80 years, was the main, if not the only, means whereby the working class, and a large part of the middle class, in Manchester, found it possible to make up for the serious deficiency of educational effort a generation or two ago.

Without going into too great detail as regards matters of history, it may be stated that the initial step for the establishment of "An Institute of Art and Industry," of which the Manchester Technical School and the School of Art were to form an integral part, was taken by the legatees of the late Sir Joseph Whitworth, Bart.

On the passing of the Technical Instruction Act, 1889, which gave certain powers to municipalities, the Governors of the new Institute decided to transfer the buildings they possessed to the Corporation, the latter undertaking to carry on the work. The transfer was effected in 1892. A sum of £13,000, representing the surplus profits of the Manchester Jubilee Exhibition of 1887, was added to the other resources at the command of the local authority—£20,000 being assigned to the establishment of a museum, £10,000 to the development of the School of Art, and the balance, £13,000, as a contribution towards the building of a new technical school. The acquisition of a site for the latter was greatly facilitated by the generosity of the Whitworth legatees. The school, in fact, occupies the very site of the old Whitworth engineering works.

The new building, now known as the Municipal School of Technology, is one of the largest and handsomest buildings in the city. Oblong in plan, it comprises six stories, the corridors on each floor being lit from two spacious areas, whilst the class rooms and laboratories are all lighted from the outside. The chief entrance is from Sackville Street. The value of the sites, structures, and equipment of this building, and the Municipal School of Art, is estimated at £300,000 or thereabouts.

The electricity department contains two large lecture theatres, four laboratories for work in physics and electrotechnics, a well equipped research laboratory, two large dynamo and motor testing rooms, a standardising laboratory, a high-pressure room, electro-chemical, photometric, and optical laboratories; together with instrument testing, cable testing, and experimental accumulator rooms—in all, 20 rooms, which are situated on four floors, on the side of the school fronting Whitworth Street. The heavy plant and machinery is installed in the basement, which is well lighted; and a sub-basement, entirely dark, is devoted to photometry, optical work, and physical work requiring a constant temperature. The plant available for testing includes four 100-KW. steam dynamos of different types, the engines being supplied by Messrs. Marshall, Browett-Lindley, Willans, and Robb (U.S.A.), and the dynamos by Messrs. Scott and Mountain, Dick Kerr, Mather & Platt, and Bruce Peebles; there is also a 50-KW. turbo-dynamo by Parsons. The Lancashire Dynamo Co. supplied a balancer-booster, and Messrs. Cowans made the main switchboard. There are over 70 motors, aggregating 823 H.P., and varying in size from ½ to 200 H.P. These motors have been carefully selected, and are representative of the best makers; they are available for testing under different conditions in various parts of the building. These are in addition to the large equipment of motors in the dynamo rooms, which are used for experimental purposes only. There is also a Tudor battery.

Electrical Engineering Laboratory No. 1 contains the following plant:—On the right-hand side of the room is a set of four machines, made by Kolben, of Prague, together with a four-panel marble switchboard, by Bertram, of Frankfort-on-Maine, supplied by Messrs. Witting Bros. This set furnishes an illustration of a central station with alternating supply. The alternators are of the inductor type, the revolving part consisting of iron only. The stationary armature is wound so as to give either one or two-phase currents. The alternators are driven by two 220-volt motors. When one of the alternators is run up to synchronism with the other it can either be run in parallel as a generator or as a synchronous motor, and its direct-current motor as a dynamo. Each alternator gives 10 KW. single and 15 KW. two-phase.

On the same side of the room also are installed an Oerlikon three-phase alternator for 200 volts and 50 periods, to give 20 KW., provided with an armature rotating in a four-pole field, and directly coupled to a 400-volt motor, driven from the city mains. The machines are controlled by switchboards made by Messrs. Dorman & Smith, of Salford, and the motor is provided with a 25-H.P. Sturtevant starter.

In the centre of the room, fixed within a pit, is the truck of an electric tramcar, made by the English Electric Manufacturing Co., of Preston. It is provided with two continuous-current motors of 25 H.P., designed by the late Prof. Short. The truck is mounted on friction wheels and coupled to a fly-wheel, whose mass can be altered, being built in segments for the purpose. The frame work of the car carries four galvanised iron tanks, which contain about 10 tons of water for loading the car. These tanks are furnished with gauge glasses, and inlet and outlet valves, so that the load can be varied, both in amount and in position. The whole car can be raised by means of jacks clear of the friction wheels, so that tests may be made on the motors running light. The car can then be lowered on to the friction wheels, and problems relating to efficiency and acceleration studied. The acceleration can be increased by the use of an external motor representing the effect of motion on a down grade.

The machinery beneath the car has been made by Messrs. Isaac Storey & Sons, of Manchester, to the designs of Dr. Nicolson, principal of the Mechanical Engineering Department. The motors are furnished with various types of controllers. It is proposed, after a complete examination of the continuous current motors has been carried out, to replace them with three-phase motors for the purpose of comparison.

On the left-hand side of the room is a fine triple set of machines by the British Schuckert Co. The central machine is a shunt-wound motor of 60 H.P., 220 volts, and it is coupled on either side to a machine having an output of 40 KW. The right-hand machine is for electro-chemical and other purposes, and gives 600 amperes at 70 volts. The left-hand machine is a 550-volt generator, and is used for driving the tramcar motors. This machine is provided with slip-rings, so that it can be run as a single or three-phase alternator.

As a compound generator it is self-exciting, but as an alternator it is excited from the 220-volt bus-bars supplied from the School mains, the two halves of the field then being in parallel. The change from series to parallel connections is performed at the machine and not at the switchboard, and the direct current side is removed from the circuit by lifting the brushes. The speed of the combined set is about 800 r.p.m.

The switchboard by which it is controlled consists of polished white marble panels, each 1½ in. thick, carried on an iron frame, and fixed 3 ft. from the wall of the room. At the top of each panel is a single-light bracket with shade and lamp for 220 volts.

The following panels are provided:—

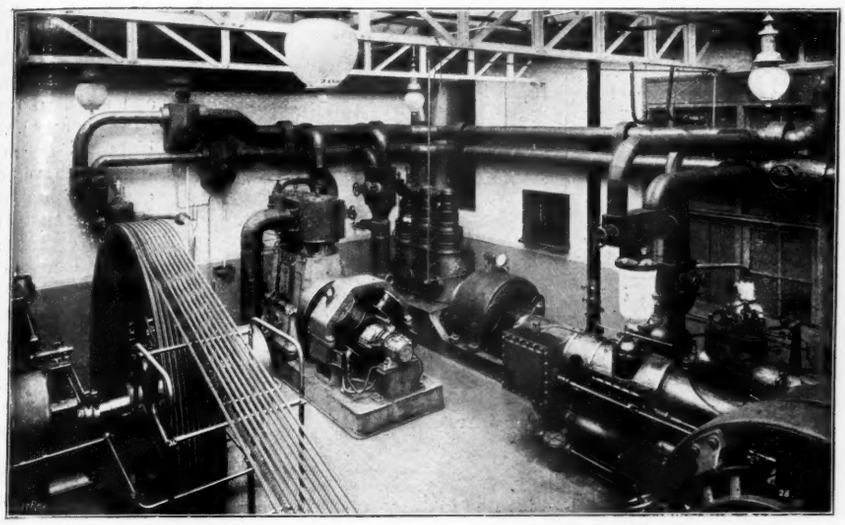
Motor panel, equipped with an automatic circuit-breaker, a main-circuit ammeter, an exciting-circuit ammeter, and an automatic motor overload and underload starting and regulating switch, enabling the speed of the motor to be increased or decreased 25 per cent.

The panel for the electro-chemical generator is fitted with a single-pole automatic circuit breaker, one D.P. main switch, main and exciting-circuit ammeters, voltmeter, a rheostat for field regulation, and two D.P. switches for feeder circuits.

The panel for the compound generator is fitted with the same appliances as No. 2, but of different capacity. The alternator panel is supplied with alternating-current voltmeter and ammeter, D.P. main switch, automatic circuit-breaker, exciter-circuit ammeter, regulating switch for the field circuit, provided with a buffer coil to take self-induction in case of breaking field circuit, and two D.P. switches for feeder circuits.

On the same side of the room, and next to the above, is a

switchboard by Messrs. Dorman & Smith, connected with a battery of accumulators of the Chloride type, installed for experimental purposes. The current is distributed to the various laboratories, and may be regulated in steps of 10 volts up to 220 volts. On this side also is a 30-KW. three-phase machine of the rotating field type, of the latest design, by Messrs. Witting Bros.



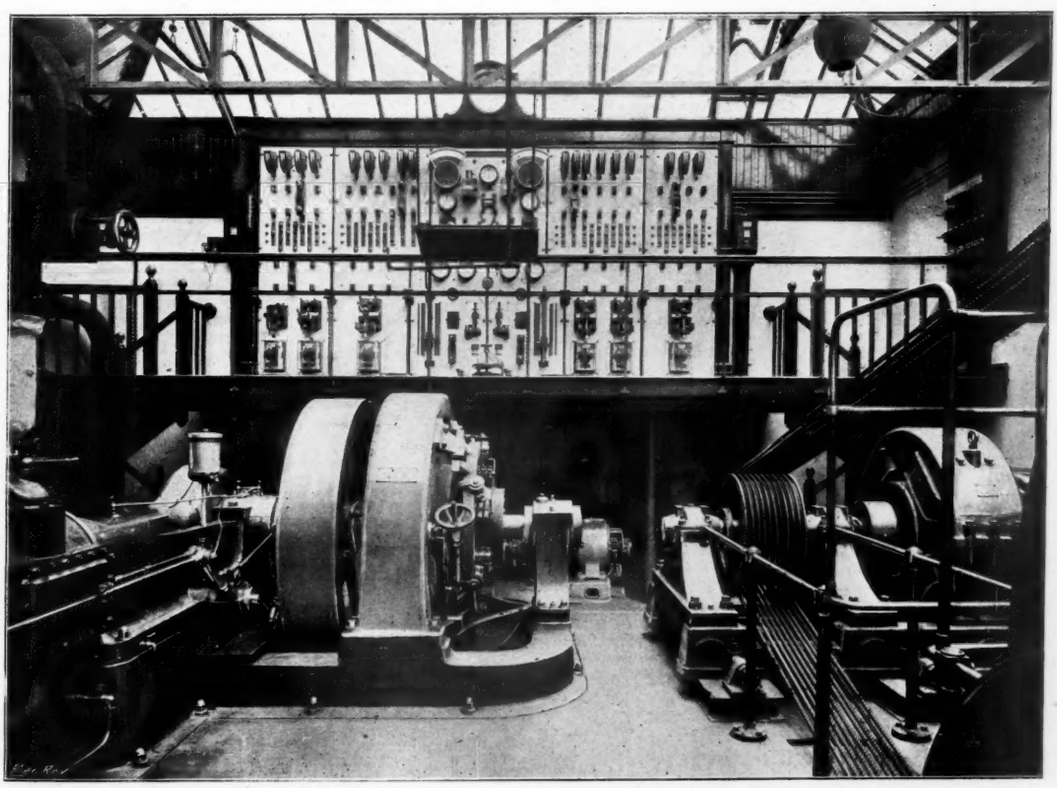
Part of the Engine Room.

In electrical engineering laboratory No. 2, the machines are of smaller size. They consist of a set of two 5-KW. rotary converters, designed for transforming from three-phase to direct current, and were supplied, together with a switchboard and transformers, by the Alioth Co., of Basle. The plant is so arranged as to represent a sub-station, as now used in a number of towns for distribution. The voltage of supply from the large alternators in room No. 1 is 200 volts. It is transformed by three-phase transformers, and converted to 100 volts direct current. Experiments in synchronising and parallel running can be made with this set.

Other alternating-current plant in this room includes a set of four single-phase motors, made by the Langdon Davies Co., the Oerlikon Co., Witting Bros. (Heyland type), and Fuller-Wenstrom. These are arranged for brake and efficiency tests. A two-phase motor has been supplied by Brown, Boveri & Co., of Baden, and two three-phase motors—one by the Oerlikon Co., and the other by the Electrical Co. The British Schuckert Co. have supplied transformers representing Scott's system of conversion from three-phase to two-phase.

The direct current plant includes a motor-generator, consisting of an Edison-Hopkinson machine, formerly used in lighting the temporary electrical engineering department in Whitworth Street, directly coupled to the latest type of steel-clad Mather & Platt 220-volt motor.

A set of three machines, supplied by Messrs. Bruce Peebles & Co., of Edinburgh, has been specially arranged for experimental work. These machines are connected by magnetic couplings. They are of the two-pole type, and may be run as shunt, series or compound machines. Each machine is provided with slip rings, one for two-phase current, one for three-phase, and one for six-phase, thus enabling a comparison to be made between the three types of rotary converters.



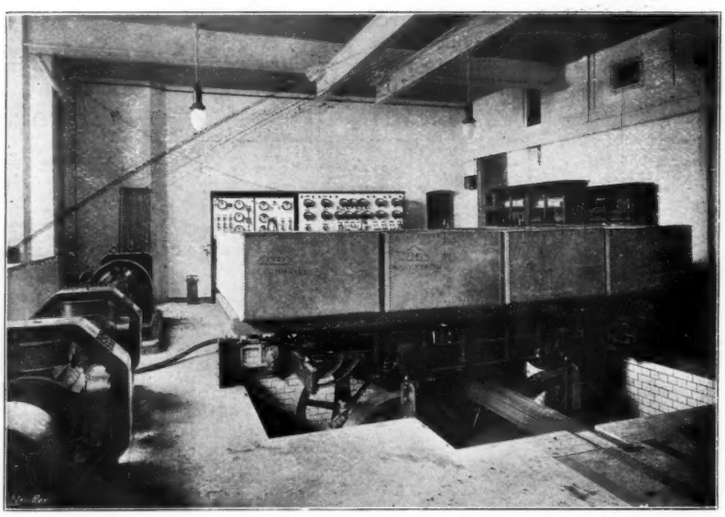
Main Switchboard and Generators in Engine Room.

This laboratory also contains similar machines for direct current working, including two direct-coupled machines made by the Crompton Co., two by Bergmann, of Berlin, and two by the International Electric Co., a motor provided

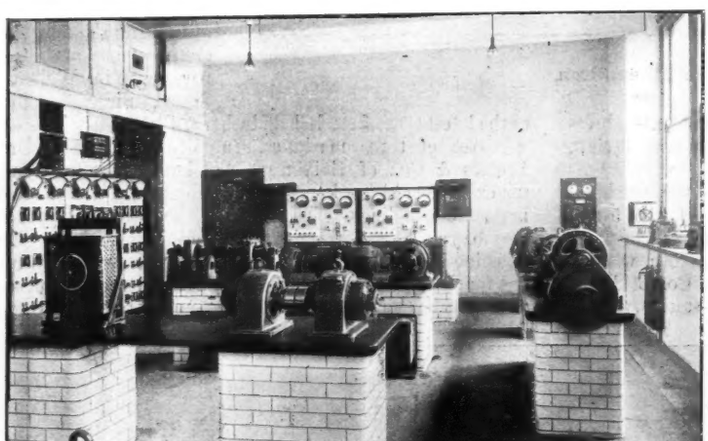
with reduction gearing made by the Electrical Co., and a Manchester-type motor.

In the same room is a large switchboard with three panels, designed to distribute at 110 or 220 volts from the school station to the various machines in the two laboratories. It is capable of controlling 100 KW. Sub-distribution switch boards are being arranged in connection with the separate machines.

The machines have been installed on white glazed brick piers, with teak or other suitable wood tops. The laboratory is lit by means of Nernst lamps.



Tramcar Motor Testing Apparatus.

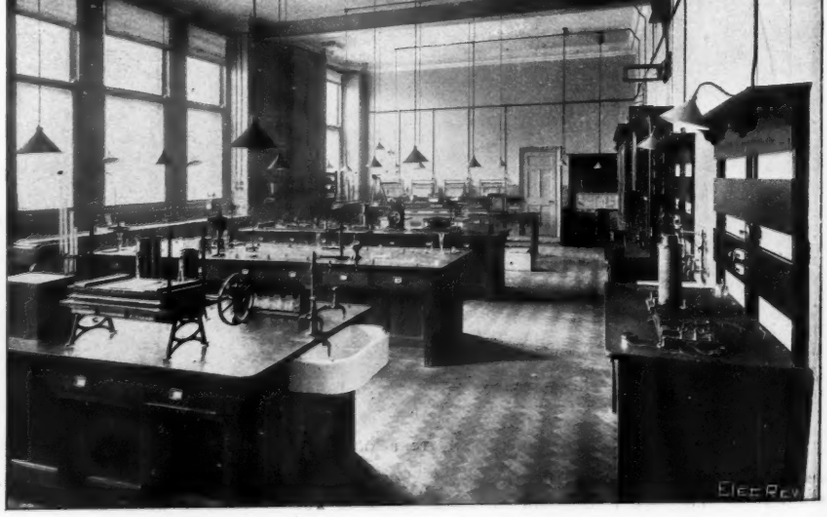


Motor-Testing Equipment in Laboratory No. 2.

Adjoining Laboratory No. 2 is a small room devoted to cable testing. It is fitted with a number of tanks, in which are the coils of cable, and arrangements are made for altering the temperature of the water.

The photometer room in the sub-basement is over 50 ft. long. It contains a Letheby-Bunsen photometer by Messrs. Alexander Wright, of Westminster. The photometer box is fitted with a reversible disc-holder, mirrors and prisms. The right-hand compartment is provided with a triple arm, enabling the following standards to be used:—(1) a candle with candle balance; (2) Methven screen; and (3) a 10-candle Clowes-Harcourt pentane standard. The left-hand compartment is fitted with a triple arm to enable tests to be made with the standard London Argand gas burner and standard bats-wing burner; and is provided with a pillar with vertical and horizontal adjustments for electric incandescent lamps. The photometer room is also furnished with the Lummer-Brodhun, Steinheil and Krüss type photometers, and has a French Carcel standard.

On the next floor the special laboratory, which is devoted entirely to research work, is fitted with Prof. Schwartz's arrangement of galvanometer test tables. All the laboratories are furnished with continuous, alternating and three-phase currents at various pressures. These are distributed to the benches by means of a double-plug switchboard. The upper portion of this board is for the purpose of distributing at 2, 4, 6, 8 or 10 volts, from a battery of five large accumulators placed on each floor. Each board consists of six vertical working, and one idle, bus-bars, each of the bars being provided with studs and thimbles for 40 amperes, and furnished with a cut-out. Connected by means of plugs to these vertical bars are eight circuits on 16 horizontal bars like the above. These are provided with cut-outs for 10 amperes; the bars are mounted on polished marble slabs, and enclosed in a glazed case. The lower board, which is made of "stabilit," carries the cables



Physical Laboratory.

connected to the experimental terminals on the benches, and each circuit is provided with two plugs, which can be plugged on to (*a*) 110 volts; (*b*) 220 volts; (*c*) experimental accumulators up to 110 volts, in steps of 4 volts; (*d*) experimental accumulators up to 220 volts, in steps of 10 volts; (*e*) the marble board mentioned above up to 10 volts, in steps of 2 volts; and (*f*) experimental circuits to the dynamo rooms, whereby the current from any machine can be got to any bench in the laboratories. A system of distribution of this sort is necessarily complex, but a great deal of care has been devoted to its simplification, and the boards, as designed and made in the school, certainly have not any appearance of complexity in working. The fit of the plugs is exceptionally good, and currents up to 50 amperes can be distributed without any trouble. The whole of the cables at the back of these boards are so arranged as to be readily got at.

Lecture Theatre.

In this connection, mention may be made of the portable testing stands which are in use throughout the department. They consist of a light teak framework, about 5 ft. high, mounted on castors and furnished with levelling screws with flat feet, which lift them off the castors when they are in position and render them stable. They are furnished at the top with a number of teak fillets, about 4 in. wide and ½ in. thick, spaced 3 in. apart. All the measuring instruments are furnished with small screw clips for fitting over the edges of these fillets. The walls of the room are also fitted with similar fillets, plugged to them, and table stands for instruments are provided of the same standard size, so that an instrument can be adjusted either on the portable testing stands, the table stands, or on the fillets round the walls in any of the rooms of the department in a few moments.

The Advanced Physical Laboratory is a very fine room, and is equipped with the latest and best apparatus for the study of technical physics and the higher branches of electrical and magnetic work. It is impossible in the space of this article to give a detailed description of the instrumental equipment. It is varied and extensive.

In the Electro-technical Laboratory is to be seen a very good collection of meters, including all the best English and Continental types.

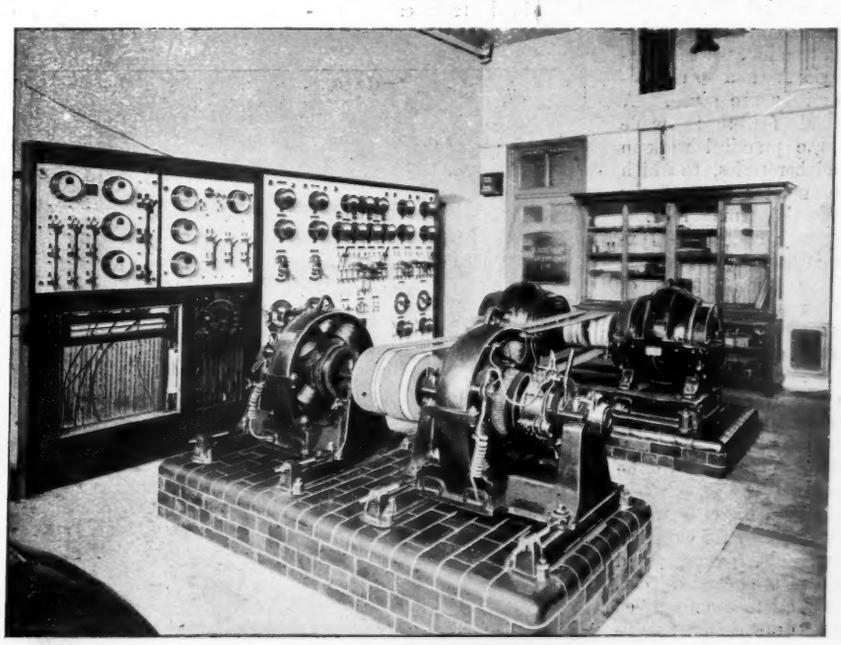
The lecture theatres are spacious and well lighted. They contain every facility for experimental work, and are furnished with fine electric projection lanterns.

On the second floor a large room is devoted to electric wiring and fitting, and the rooms in the department have been wired on different systems for the purpose of illustration. There may be seen the Simplex conduit, Bergmann's metal tube, Peschel's insulator system, and various other conduit systems.

A special feature has been made of the Standardising Laboratory, which has been carefully equipped with standard instruments of English, French and German manufacture. Current measurements up to 4,000 amperes can be dealt with, and pressures up to 100,000 volts are available. The high pressure room is furnished with a 20-KW. transformer set by the British Westinghouse Co., and fitted with a Stillwell regulator for voltages up to 100,000.

It only remains to say a few words about the teaching staff and the work that is being done. The head of the department is Prof. Alfred Schwartz, A.K.C., A.M.I.C.E., M.I.E.E. Prof. Schwartz was educated at King's College, London, of which he is an associate. After a period in works, he was articled to Prof. Henry Robinson, of Westminster, with whom he had six years' experience in consulting and Parliamentary work in connection with central stations and supply schemes. He was appointed in 1895 head of the electrical engineering department of the South-Western Polytechnic, Chelsea, where he was responsible for the design and arrangement of the whole of the electrical laboratories. He has travelled very largely, and is particularly interested in traction and power transmission work, and its development in this country. He was appointed head of the department of Physics and Electrical Engineering in the Manchester School in July, 1901.

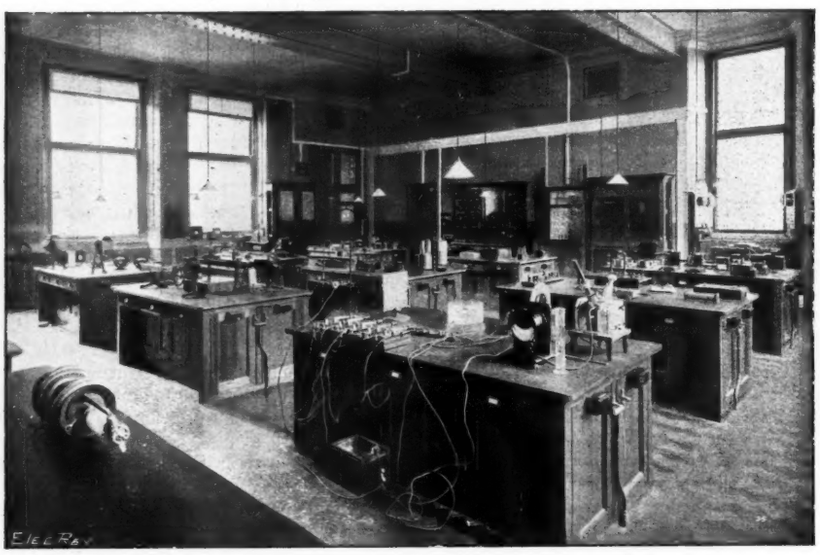
Prof. Schwartz is ably assisted by Prof. W. W. Haldane



Electrical Engineering Laboratory.—No. 1.

Gee, B.Sc. (London), A.M.I.E.E., and the lecturers of the department are Messrs. A. Adamson, Assoc.R.C.Sc.L., and C. Kingbrunner, Diploma Elect. Eng. Technical High School, Vienna.

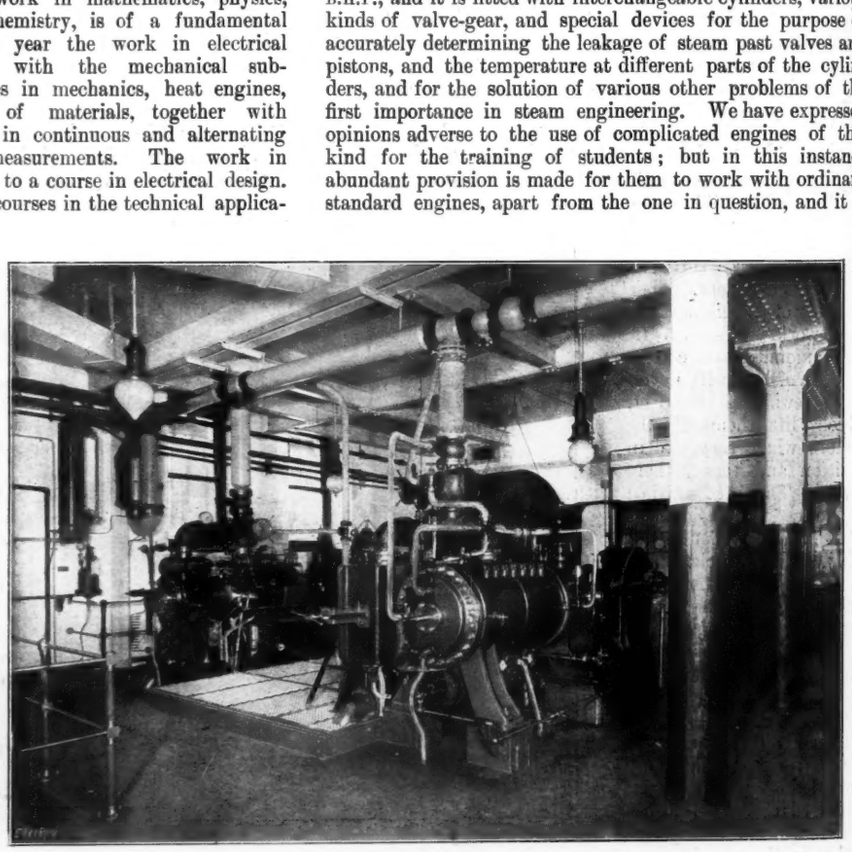
There are now about 200 day students attending in the technical departments of the school, in a three years' course. The first year's course is common to all engineering students, and the work in mathematics, physics, mechanics, drawing and chemistry, is of a fundamental character. In the second year the work in electrical engineering runs parallel with the mechanical subjects, which include courses in mechanics, heat engines, hydraulics and properties of materials, together with lecture and laboratory work in continuous and alternating currents and electrical measurements. The work in mechanical drawing leads up to a course in electrical design. In the third year extended courses in the technical applications of electricity to lighting, traction, power transmission, and electro-chemistry are given. A special feature is made of the practical work in the laboratories, to which the greater part of the student's time is now devoted; and a careful experimental study is made of the leading types of dynamos, motors, transformers and electrical instruments and appliances. Advanced work in the hydraulic and heat engine laboratories is also undertaken. Special attention is paid to the design classes, where original designs in working drawings for electrical appliances, dynamos and motors are carried out. Instruction is also given in the drawing-up of specifications; and quantities are taken out and estimates prepared for electrical work of various kinds.



Electro-Technical Laboratory.

In the evening classes a rigorous examination of the students is made, and each student has to be provided with a permit showing that he is fitted to profit by the instruction to be given in the class, before he is admitted. This is arranged for by the teachers being present in the class hours, for a fortnight before the opening of the session for the purpose of interviewing intending students; on the result of such interviews the permits are granted. The classes in the evening are attended very largely by draughtsmen, test-room assistants, foremen and managers of the numerous and important electrical works established in the Manchester district. The systematic courses in electrical engineering have been arranged over five years, and the fundamental work in the allied subjects of mathematics and mechanical engineering is insisted upon.

While in the foregoing we have made no mention of the mechanical engineering department, we have selected for illustration the experimental engine designed by Dr. Nicolson, late of McGill University, Montreal, who has been engaged with a staff of draughtsmen for the past two years in preparing the designs for the equipment of this department. It would be impossible for us to attempt a detailed description of this engine here; suffice it to say, that the output is 350 B.H.P., and it is fitted with interchangeable cylinders, various kinds of valve-gear, and special devices for the purpose of accurately determining the leakage of steam past valves and pistons, and the temperature at different parts of the cylinders, and for the solution of various other problems of the first importance in steam engineering. We have expressed opinions adverse to the use of complicated engines of this kind for the training of students; but in this instance abundant provision is made for them to work with ordinary standard engines, apart from the one in question, and it is important to note that it is the intention of the authorities to enlist the services of experienced engineers in carrying out important researches with this engine and, in fact, with other portions of the equipment.



Experimental Engine in Mechanical Engineering Department.

## PROF. SIDNEY H. SHORT.

THE premature and somewhat sudden death of Prof. Sidney Short from appendicitis, which we briefly announced in our last issue, has removed an interesting personality; a prolific inventor, and an engineer of great attainments. He had combined in a rare degree scientific knowledge and a true insight into the practical possibilities of electricity. The exact circumstances which led to him continuing his important work in this country are set forth below, and it may be truly said of him that he was one of the few American engineers who, after a residence in this country, have left a clear impression upon English engineering practice.

He was a man of high culture, yet notwithstanding his professorial attainments, his work lay rather in the direction of practical engineering than in the schools and laboratories. Some years before Prof. Short came to this country he had achieved a high position among a band of brilliant American engineers; he had seen and participated in the early developments of electric traction, and was quick to appreciate the real problem, and to seek for its solution in the modifications and developments of the electric motor. When one considers the state of the art at that period, it was no small achievement to design a motor to work under the peculiar and special conditions obtaining in electric traction, and it is no exaggeration to say that the high state of efficiency which now characterises all parts of tramway appliances owes much to the splendid work accomplished by Prof. Short. Though a pioneer in the field of electric traction, he had, unlike many of his earlier *confrères*, remained throughout his career one of the leading authorities on all matters appertaining to electric traction, and to all problems connected with tramway enterprise, he brought to the day of his death an enthusiasm and a vigorous insight, coupled with a great experience and ripened judgment.

In this country he had been closely associated with a concern which has shown the possibility of economically and efficiently manufacturing tramway apparatus, a department of applied electricity, which had been for many years utterly neglected by English firms. Without exaggeration he may be said to have completely revolutionised in this country the design of continuous-current generators, and an eloquent testimony to his skill as a designer is to be found in the many splendid examples of machines at home and abroad. Nor did he hesitate to give to the world the benefit of his experience: to all who cared to ask he freely gave the details of his designs, and that his views found ready acceptance is obvious from the fact that many of his improvements have become embodied in standard practice. In a sense he may be said to have completed much of the work for which he visited this country. He had collected round him a staff of brilliant men who had been associated with him for years in the design of the apparatus with which his name had been closely identified, and it redounds to his ability as an organiser that even without the master mind his work can be continued without a break.

The later years of his life had been in a great measure devoted to the problems arising out of the application of electricity to railway service, and his close study of the subject has enabled him to leave a mass of data and standard designs, which no doubt will be largely adopted in much of the conversion from steam to electricity that is bound to take place on many of our existing railways.

His personal qualities had endeared him to a large and ever increasing circle, and he possessed a frankness and a charm of manner behind which were the sterling qualities that had raised him to a high position among his fellow men.

Prof. Sidney Howe Short, electrical engineer, was born in Columbus, O., October 8th, 1858: he was the second son of John Short, a manufacturer, and Elizabeth Cowen, his wife. From the public school of Columbus, Sidney Howe Short passed to the Capital University, but soon left it to enter the Ohio State University, where he became a student under Prof. Mendenhall, of the technological department, and an assistant in the laboratory.

Like most inventors, he had shown mechanical ingenuity in his very childhood. Before he was 14 he was an expert telegraph operator, and had equipped his father's house with a burglar alarm system and other electrical devices. In 1876 he perfected a long-distance telephone transmitter, which he patented, and afterwards sold to the Gold and Stock Telegraph Co. (now a part of the Be Telephone Co.).

In 1878 Mr. Short was elected Assistant Professor of Physics and Director of the Laboratory; he graduated in 1880, with the degree of B.S., and immediately accepted the position of Professor of Physics and Chemistry, and Vice-President of the University of Denver, Colorado. He developed these departments so rapidly that, in 1882, the work was found too much for one person, and he was relieved of the chemical department, in order that his entire time might be devoted to Physical Science.

While in Denver, Prof. Short invented a double reduction motor for street railways. He became so enthusiastic in this work, that in 1885 he resigned his professorship, to concentrate his entire attention upon electric railway work, and soon had several lines working in Western cities.

In 1889 he removed to Cleveland, O., where the Short Electric Railway Co., of which the Brush Electric Co. was a large shareholder, was formed to manufacture his railway machinery. In 1892 the Thomson-Houston Co. bought out the Brush Electric Co., the Short Electric Railway, and later the Edison Companies, thus forming the existing General Electric Co. In 1893 Mr. Short became connected with the Walker Manufacturing Co., of Cleveland, O. The Walker Co. immediately entered the electric traction field with an entirely new system of apparatus of Mr. Short's design, and rapidly became a formidable competitor of the General Electric and Westinghouse Cos., not only in the United States, but in Europe and throughout the world. In 1898, the Walker Co. had become so important a factor in the electrical situation, that its absorption was decided upon and accomplished by the financial interests controlling the Westinghouse Co.

In December of that year Mr. Short sailed for Europe with two objects in view, one of which was to take a long holiday, and the other, which quickly submerged it, to complete the arrangements which had already been under discussion with Messrs. Dick, Kerr and Co., Ltd., for the construction of works in England for the manufacture of apparatus under his patents. The preliminaries for the carrying out of this undertaking were quickly arranged, and in June, 1899, work was commenced on the excavations for the new buildings at Preston; only a year later the formal opening took place, the actual production of traction machinery being already well under way.

Since that date Mr. Short has held the position of technical director of the English Electric Manufacturing Co., Ltd, and the wide range of the patents and designs by himself and the technical staff which he had organised for the company covers apparatus for electric traction ranging from ordinary tramway equipments to those for the heaviest railway service, generators from the smallest size up to those of 3,000 or 4,000 KW. capacity, and a complete range of polyphase machinery for power and transmission work. It will be generally agreed by electrical engineers throughout the world that in his designs Mr. Short has distinctly improved whatever type of machinery he has touched, and in many cases these improvements have been of the most vital and far-reaching nature. Mr. Short, during the past year, was engaged upon plans which have recently been carried through for the erection of large shops in Paris for the manufacture of machinery under his patents.

It has been known to his friends for some time that he regarded his work in Europe as drawing to a finish, and that it was his intention a little later on to return to America with a view to re-entering the electrical field there, and carrying out on independent lines an undertaking of a similar nature to that with which he had been associated in England.

Prof. Short was a Fellow of the American Society for the Advancement of Science, a Member of the Cleveland Electrical Society, the American Institute of Electrical Engineers, the Institution of Electrical Engineers in London, the Engineering Society of Liverpool, and the New York Electrical Society. He was a Member of the United States Electrical Congress in 1884 at Philadelphia, the International Congress of Electricians at Chicago in 1893, and the International Congress of Electricity in Paris in 1900. Over 500 patents have been issued in his name in the United States and foreign countries, mostly on electrical machinery.

He was married in Washington, D.C., July 26th, 1881, to Mary F. Morrison, a resident of Columbus; they had three sons and a daughter. Prof. Short was only 44 years of age at the time of his death.

## ELECTRIC TRACTION NOTES.

(*Continued from page* 741.)

**Manchester.**—The prospective opening of the Manchester and Withington electric tramway, which will compete with the Midland Railway Co. for an important part of its suburban traffic, has led the company to announce large reductions in the price of first and third-class season tickets from November 1st.

**Farnworth.**—The result of the working of the electricity department for the quarter ending September 30th, 1902, shows:—105,303 units sold; receipts, £1,104 12s.; working expenditure, £538 5s.; working expenditure per unit sold = 1·22d. In regard to power supply, the motors connected are 160 H.P., or over 200 H.P. applied for. The tramways revenue was £1,912 18s.; the working expenses, £1,748 (7·16d. per car-mile), including cost of replacing car wheels broken by running over the old Manchester Road track which is now being relaid, and a sum paid to the Bolton Corporation for renewing the electrical equipment of the Manchester Road track, which track had been leased to them till last June. It is found that the d

fares have not been a success, and the Committee has decided, subject to the approval of the Council, to abolish them. Mr. J. D. Pember, A.M.I.E.E., is the Council's engineer and tramway manager.

**Middlesex.**—On Friday an inquiry was held at Alexandra Palace with regard to proposals of the Middlesex County Council to establish an electrical tramway in the suburbs of North and North-East London. For carrying out this undertaking the County Council now applied for further powers from the Board of Trade, through the Light Railway Commissioners, to widen certain roads in various parts of the area through which the lines will pass. The inquiry was largely attended, including representatives of the Wood Green, Hornsey and Friern Barnet District Councils and tradesmen affected by the proposals. Objections were offered by the Wood Green Council, but the consideration of these were postponed until their Lordships came to consider the questions of clauses. Other objections were also made.

The Light Railway Commissions held an inquiry at the offices of the Willesden U.D.C., Dyne Road, Kilburn, into the application of the Middlesex C.C. for power to construct certain light railways within their area. The said railways as proposed were as follows:—(1) From Finchley Road (at the cross roads, Golder's Green) through North End Road, Hendon, to the Edgware Road. (2) From the "Crown" at Cricklewood to Kilburn station (L.N.W. Railway). (3) From the end of Chichele Road, near the "Crown" aforesaid, through Willesden High Road, Church Road, to Craven Park, Harlesden. The inquiry commenced on Monday, 20th inst., and was adjourned until Thursday, 23rd, when the following decisions were arrived at:—

Railway No. 1.—The Commissioners stated that the Edgware and Hampstead Railway having passed both Houses of Parliament, they considered that this Railway No. 1 was not pressing, and would not recommend an order in this case.

Railway No. 2.—This application was withdrawn, as it was stated that the L.C.C. intended to apply to Parliament for powers to construct a tramway along the Edgware Road. This road is vested jointly in the M.C.C. and the L.C.C. Railway No. 3. The Commissioners reserved their decision in this case.

The M.C.C. has resolved to promote a Bill in Parliament for the construction of a tramway through Hendon, along the same route as No. 1 aforesaid, and another similar to No. 2 before mentioned.

Last week Lord George Hamilton, in the capacity of a governor of Harrow School, gave evidence before the inquiry held by the Light Railway Commissioners into an application made by the Middlesex County Council for sanction to run a line of electric trams round the base of Harrow Hill. The proposal is to construct the tramline from Willesden down the Harrow Road, and then through Harrow, Wealdstone, and Stanmore to Edgware, where it would form a connection with a similar line which has already been sanctioned, to run out from Cricklewood along the Edgware Road. Such a line of trams, Lord George Hamilton declared, would have a most prejudicial effect upon Harrow School. He thought that where the interests of a great national institution were so vitally affected, a few thousands of pounds should not be given too much consideration, but that another route should be adopted. Similar evidence was given by Lord Spencer, another of the governors.

**Redruth—Camborne.**—This electric tramline of the Urban Electricity Supply Co. is completed. If the B. of T. inspection takes place in time the cars will start running next week.

**Shildon.**—The U.D.C. has decided to re-open negotiations with Mr. John Heslop with a view to securing electric tramways for the town and district.

**South Lancashire Trams.**—On Monday last week the sections of the South Lancashire tramways, connecting Lowton, Leigh, Howe Bridge, Atherton and Bolton, were opened for public traffic.

**South Shields.**—At the meeting of the T.C. on the 22nd inst. the matter of the Tramways Bill was again brought up, and the Bill as drafted by the Council in Committee was approved and was to come up for final approval on the 29th inst. At the meeting of the South Shields Committee on the 21st inst. a letter was read from Mr. S. Sellon on behalf of the B.E.T., stating that they were promoting a Bill for tramways from South Shields to Sunderland, and asking the Committee to meet the representatives of the company to discuss the terms on which the Corporation would be prepared to give their consent to the company's proposals, and also to afford the Corporation all the information they desired. It was agreed that the Committee should receive the representatives of the company, but that before they met the Committee they should furnish information as to the exact nature of the company's proposals, and the powers they intended to seek in the proposed Bill. On the 24th inst. another meeting of the Committee was held, and a further letter from Mr. Sellon was laid before it. Our correspondent understands that this pointed out that the existing tramways in South Shields were leased to the B.E.T. for a term which expires on February 1st, 1908, terminable, however, on February 1st, 1906, at the option of the Corporation, and this prevented the conversion of the tramways into an electric system before the dates named, except by an amicable arrangement. The company therefore offered if the Corporation met them in other ways, to surrender its lease forthwith, and to take up the new lease on the line being reconstructed and equipped for electric traction, to be concurrent with the lease of the other lines to be constructed in South Shields. The company was prepared to transfer to the Council so much of the Jarrow and South Shields light railway as is within the borough on terms to be agreed. The company was prepared to take a lease for 28 years of all suitable tramways to be constructed in the borough; the company to pay the interest and sinking fund upon the capital expended in constructing, equipping and purchasing the lines; that the company would relieve the borough debt of the £10,000 standing against the tramway account by including that amount in the tramway capital. It is further suggested that a saving would be effected if all the lines were included in the Bill the company is to promote, but if the Council prefers itself to promote the lines in the borough, the company did not desire to oppose that course provided a lease was arranged for. The company also express themselves as willing to consider the question of bearing some part of the cost of widening Fowler Street. A good deal of discussion was provoked by the letter, and it was felt that it went far beyond what was originally suggested. It was decided that it should be intimated to the company that the Committee were only prepared to consider proposals as to the Whitburn and Fowler Street route. What will be the outcome it is difficult to surmise, as a special meeting of the Council was called for Wednesday to formally order the promotion of a Bill for the construction of the tramways.

**Southport.**—All the tramlines are now laid from Shakespeare Street to the Birkdale boundary, and most of the line has also been laid up Duke Street.

**Stroud.**—It appears probable that the proposed system of electric tramways for Stroud and district is not to be dropped as a consequence of the somewhat sudden death of Mr. T. Nevins, the original promoter. A syndicate, consisting mainly of local manufacturers, has been formed, and it is proposed to construct the line from Stroud to Nailsworth, Stonehouse and Chalford. The manufacturing village of Painswick, which was included in the first scheme, has been left out, and the entire proposal has already received the favourable consideration of the County Council.

## TELEGRAPH AND TELEPHONE NOTES.

**Cuban Telephones.**—It is reported from New York that the Cuban Congress has granted to the American National Telephone Co. a monopoly for the whole island for 50 years.

**London—Brussels Telephone.**—Owing to the unsatisfactory nature of the trials of the London—Brussels telephone from the Belgian side with English provincial towns, a delay has occurred which was not anticipated, and it is probable that, instead of the new line being opened to the public next month as had been expected, it will be only during the first months of next year that the line can be employed for regular service. The line would have long ago been inaugurated were it not for the unfortunate accident that occurred when the cable was being laid in the first instance, at a moment when several miles of it had been put down. It was then discovered that the cable was defective, a break having occurred. The terminal points of the submarine section of the cable are St. Margaret's Bay, near Dover, and La Panne, on the Belgian coastline. The entire work of laying the cable was carried out under the jurisdiction of the English Post Office Department, by its two vessels, the *Alert* and the *Monarch*. The cable is the longest of its kind that has yet been laid, being 90 kilometres in length. It comprises two circuits, and cost nearly £4[illegible],000. The complete installation will cost about £80,000, which will be equally shared by the two nations. From and to Belgium communication will only be feasible with Antwerp and Brussels. If communications are numerous, however, and the new line proves profitable, the Belgium Government will instal connections with the other principal Belgian towns. In Brussels it will be possible for subscribers to the Post Office telephone to communicate with London from their houses. In Antwerp, however, owing to the imperfect nature of the local telephone system this will not be possible. The rate for messages has been fixed by agreement between the two Governments at 8s. or 10 fr. for three minutes' conversation. No subscriptions will be issued either in England or Belgium. The day and night tariffs will be the same. The cost of maintenance of the new line will be borne in equal parts by the two Governments.

In the House of Commons on 23rd inst, replying to Mr Henniker Heaton, Mr. Austen Chamberlain said, "A new cable has been laid to Belgium, and telephonic communication between London and Brussels will be opened as soon as the necessary arrangements can be completed. The establishment of communication between London and Berlin is not at present feasible."

**Wireless Telegraphy.**—It is stated by a Central News Rome correspondent that wireless telegraphy apparatus is to be established at all stations, and on all passenger trains on the Italian railways.

The Telegraphs Amendment Bill, giving the Government control of wireless telegraphy, passed its second reading in the Cape House of Assembly on 24th inst.

A Berlin Press correspondent says that Austria-Hungary, Italy, Russia, and the United States have accepted the invitation issued by Germany to the International conference for the regulation of wireless telegraphy. Replies to the German proposal have not yet been received from Great Britain or France.

## Telegraphic Interruptions and Repairs :—

| Cables. | Interrupted. | Repaired. |
|---|---|---|
| Latakia-Cyprus | June 20, 1902 | |
| Communication with Carthagena and Barranquilla (Columbia) | Dec. 8, 1900 | |
| Trinidad-Demerara No. 1 | Aug. 27, 1901 | |
| Dominica-Martinique | May 8, 1902 | |
| St. Lucia-Martinique | May 8, 1902 | |
| Guadeloupe-Martinique | May 9, 1902 | |
| Santa Cruz de Teneriffe to Tejita de Teneriffe | July 4, 1902 | |
| Puerto Plata-Martinique | July 10, 1902 | |
| Guantanamo-Mole St. Nicholas | Aug. 4, 1902 | |
| Cayenne-Pinheiro | Aug. 13, 1902 | |
| St. Lucia-St. Vincent | Sept. 19, 1902 | |
| Reissi-Issa | Oct. 22, 1902 | |
| Reissi-Yemani | Oct. 22, 1902 | |
| Carcavel os-Ponta Delgada | Oct. 23, 1902 | |
| Landlines :— | | |
| Route *via* Hanekin on Persian territory | Feb. 24, 1900 | |
| Communication with Tientsin and Taku *via* Helampo | July 18, 1900 | |
| ommunication with Maranham | Sept. 19, 1902 | |

**Telegraphs to the Far East.**—In the House of Commons, on 28th inst., Sir Edward Sassoon asked the Postmaster-General "whether he was aware that cable rates from Hong Kong to England *vid* the Great Northern line are practically double those charged from Hong Kong to Russia; and whether he would remonstrate with the company, which enjoyed a monopoly of landing rights on British territory, with the view of bringing about an abrogation of this discrimination between British and Russian merchants and bankers."—Mr. A. Chamberlain replied that he was aware of the difference in charge to which attention was called. It was in accordance with a well established principle of the Telegraph Convention that adjoining countries like Russia and China or China and British India may make arrangements between themselves for lower rates than those which are generally applicable; and Hong Kong, as forming geographically part of China, has been brought within the terms of the special agreements regulating telegraphic rates between China and Russia on the one hand and China and British India on the other. These and other charges had been under the consideration of the Colonial Office and the Post Office, and he (Mr. Chamberlain) hoped that it might be possible to reduce the rate between this country and Hong Kong. The Great Northern Company, however, did not possess a monopoly of landing rights in any British territory.

## CONTRACTS OPEN AND CLOSED.

### OPEN.

**Aston Manor.**—October 31st. Condensers for electricity works. See "Official Notices" October 10th.

**Bristol.**—November 14th. Arc cables. See "Official Notices" October 24th.

**Buckinghamshire.**—November 8th. Electric lighting, telephones, and tell-tales for the County Asylum. See "Official Notices" to-day.

**Burton-upon-Trent.**—November 5th. Overhead equipment for tramways. See "Official Notices" October 17th.

**Copenhagen.**—November 17th. Two dynamos, switchboard, &c. See "Official Notices" October 17th.

**Dartford.**—November 12th. House wiring. See "Official Notices" October 24th.

**Erith.**—November 12th. Meters and cut-outs. See "Official Notices" to-day.

**France.**—January 1st. The Prefectural authorities of the department of Calvados are inviting projects until January 1st, 1903, for the construction and working of an electric tramway, for the transport of passengers and goods between Trouville and Honfleur, a distance of about 10 miles. Particulars may be obtained from, and proposals are to be sent to, La Prefecture de Calvados, Caen.

**Halifax.**—November 20th. 750-KW. steam dynamo with condenser. See "Official Notices" October 24th.

**L.C.C.**—50-ton electric traveller with an auxiliary two-ton hoist for the Greenwich tramways power station. Specifications, &c., at Spring Gardens, £2.

**London.**—November 31th. The L.C.C. invites tenders for road-work and plate laying for the reconstruction of certain tramways on the conduit system. Engineers' Department, Spring Gardens.

**Lowesoft.**—November 26th. Overhead equipment and poles; cables, &c, for tramways. See "Official Notices" to-day.

**Mansfield.**—October 31st. Electric wiring of the Town Hall. Specifications from Mr. Hewlett at the electricity works.

**Newcastle-upon-Tyne.**—November 8th. A triple-expansion direct-coupled 3,000-H.P. engine for the Corporation tramways station. Mr. A. E. Le Rossignol, general manager and engineer. Deposit for specifications, £3 3s. See "Official Notices" October 17th.

**Pontypridd.**—November 22nd. Tramways, permanent way, traveller and storage battery. See "Official Notices" to-day.

**Radcliffe.**—November 14th. Steam dynamos; boilers, superheaters and economisers, condenser and pumps. See "Official Notices" to-day.

**Salford.**—November 12th. Lead-covered wire. See "Official Notices" to day.

**Santiago de Cuba.**—November 15th. The Municipality of Santiago de Cuba is open to receive offers for installing an electric lighting system in the town.

**Southampton.**—November 18th. (1) Car bodies; (2) electrical equipment and trucks. See "Official Notices" October 24th.

**Spain.**—November 8th. The municipal authorities of Tarrega (Catalonia province) are inviting tenders until November 8th for the concession for the electric lighting of the town during a period of 15 years. Particulars may be obtained from, and tenders are to be sent to, El Secretario del Ayuntamiento de Tarrega (Catalonia).

**St. Petersburg.**—November 1st (14th). The T.C. invites tenders for the reconstruction of the three town tramway lines, hitherto worked by horse traction, with electrical power, and the construction of an electric station. The terms of the tender, also application forms with particulars, will be sent free at once either by post or wire. The last date for the production of projects and offers is as above, and applications should be addressed: Stadt Amt, St. Petersburg, Russia.

**Sunderland.**—November 28th. Steam dynamo, three-phase motor-generators and transformers, and switchboards. See "Official Notices" October 17th.

**Tien-Tsin.**—November 30th. The Municipal Secretary at Tien-Tsin is calling for proposals for the lighting of the British concessions by electricity. See this column for August 15th.

**Warrington.**—12 months' supply of cables. See "Official Notices" to-day.

### CLOSED.

**Ashford.**—The Electric Lighting of West London District Schools, Ashford, Middlesex, has been placed in the hands of Messrs. Robert Dawson & Co., Ltd., of Stalybridge. The installation comprises dynamos, booster, accumulators, switchboards and wiring.

**Cape Colony.**—Messrs. Ferranti, Ltd., of Hollinwood, who are now carrying out many important colonial and foreign contracts for electrical power plant, have just secured the order for the supply of transformers for the King Williams Town (Cape Colony) Electric Light and Cold Storage Co.

**Leicester.**—The Tramways Committee of the T.C. have accepted the following tenders for material for the electric tramways:—North-Eastern Steel Co., Ltd., Middlesbrough, for 4,800 tons of rails, and 175 tons of fish plates, for £32,326; Hadfield's Steel Foundry Co, Ltd., Sheffield, for points, crossings, &c., and for the construction of lay-outs and special track work, at £13,041.

**London.**—The London County Council had under consideration on Tuesday the following tenders received for the supply and erection of two electric car-traversers to be used at the Clapham and Balham carsheds respectively :—

| | |
|---|---|
| Dick, Kerr & Co., London (accepted) | £900 |
| Ransomes & Rapier, Ltd., London | 920 |
| British Thomson-Houston Co., Ltd., Rugby | 964 |
| C. & A. Musker (1901), Ltd., Liverpool | 1,040 |
| R. W. Blackwell & Co., Ltd., London | 1,170 |
| T. Green & Son, Ltd., Leeds | 1,400 |

**Leeds.**—The Leeds Industrial Wholesale Co-operative Society have decided to instal engines of the Willans type for direct coupling to dynamos of the British Thomson-Houston Co.'s make, in their new power house.

**Middlesex.**—The County Council has accepted the following tenders:—Griffiths, Ltd., construction of light railways in Tottenham and Wood Green, £78,553; J. G. White & Co, Ltd., lines in Highgate and Finchley (English rails), £49,881.

**Natal.**—The Natal Government Railways, Durban, have placed the order for the boiler house equipment of 10 stokers and forced draught furnaces with automatic steam regulators and complete coal and ash elevating, conveying, and storage plant, with Messrs. Ed. Bennis & Co., Ltd., of Bolton and London.

**Newcastle-on-Tyne.** — The Wholesale Co-operative Society have decided to instal two 250-H.P. Willans engines for direct coupling to dynamos of the Westinghouse type, for supplying power to their new mills at Dunston-on-Tyne.

**Spain.**—The Westinghouse Electrical Co. have secured a contract for two 225-KW. triphase alternators for the central electric lighting station at Oria (San Sebastian).

**Swansea.**—The *Contract Journal* publishes the following list of tenders for telephone equipment for the Town Council:—Henley's Telegraph Works Co., conduits and manholes, and cables; Armstrong, Addison & Co., Sunderland, creosoted poles; Bullers, Ltd., telephone insulators; T. Aspden & Sons, Blackburn, oak arms; Bryden & Middleton, Scotstown, Glasgow, ironwork; Guest, Keen & Nettlefolds, near Birmingham, arms, bolts, &c.; F. Smith & Co., copper wire; W. F. Dennis & Co., bronze wire, stay wire, and insulated wires; International Electric Co., Ltd., Barbican, London, lightning arresters, high-tension guards, &c.; British Insulated Wire Co., batteries; Ericsson-Bell Telephone Co., Glasgow, telephone instruments; British Insulated Wire Co., switchboards.

## FORTHCOMING EVENTS.

Friday, October 31st.—At 5 p.m. Physical Society. Meeting at the rooms of the Chemical Society, Burlington House. Paper on "The Size of Atoms," by Mr. H. V. Ridout. Exhibition of "Vacuum Calorimeters," by Prof. H. L. Callendar, F.R.S.

At 8 p.m.—Institution of Mechanical Engineers, Westminster. Extra meeting. Discussion will be continued on "Oil Motor Cars of 1902," by Captain C. C. Longridge.

Saturday, November 1st.—At 7.30 p.m. At the St. Bride Foundation Institute, Bride Lane, Fleet St., E.C. Bohemian Concert of the Association of Engineers-in-charge.

The programme for the session has been issued. It includes papers as follows:—Mr. C. Harper on "Water-Tube Boilers;" Mr. W. H. Booth on "Smoke Prevention;" Mr. W. Crawford on "High Speed Engines;" and Mr. W. F. Goodrich on "The Economics of Steam Production."

Monday, November 3rd.—At 7.30 p.m. Society of Engineers. Meeting at the Royal United Service Institution, Whitehall. Paper on "Effect of Segregation on the Strength of Steel Rails," by Mr. Thomas Andrews, F.R.S.

Tuesday, November 4th.—At 8 p.m. Institution of Civil Engineers. Ordinary meeting. Presidential Address by Mr. J. C. Hawkshaw, and presentation of Medals and Prizes awarded by the Council.

Wednesday, November 5th.—At 7.30 p.m. The Institution of Electrical Engineers (Students' Section). Meeting. Paper to be read on "Steam and Electrical Exhibits at the Wolverhampton Exhibition," by Messrs. H. A. Pickett and A. B. Scorer.

At 8 p.m. Cold Storage and Ice Association meeting at the Institution of Mechanical Engineers. Paper by Dr. C. Linde on "The Technical Application of Liquid Air."

Thursday, November 6th.—At 8.30 p.m. Röntgen Society. Meeting and Presidential Address.

At 8 p.m. Civil and Mechanical Engineers' Society. Meeting at Caxton Hall, Westminster. Paper on "The General Engineering Scheme of Garden City," by E. Howard, and Presidential Address.

At 8 p.m. Chemical Society. Meeting at Burlington House.

Friday, November 7th.—At 7.30 p.m. Faraday Club. Dinner at St. Ermin's Hotel, Mr. J. Swinburne in the chair.

Thursday, November 13th.—At 8 p.m. Institution of Electrical Engineers. Premium presentation and Presidential Address by Mr. J. Swinburne.

## NOTES.

**A U.S. Battleship Installation.**—An American exchange says that the new battleship *Connecticut* is to be lighted throughout by electricity. The electric plant on the ship will consist of eight 100-KW. steam-driven generating sets, all of 125 volts at the terminals, disposed in two separate and independent dynamo rooms. Six electrically-driven generators will supply current to turret turning motors. There will be 1,100 electric fixtures, complete, with necessary incandescent lamps and outlets; 10 enclosed arc lamps located in engine and fire rooms; six 30-in. searchlights mounted on platforms on bridges, with spare parts; two truck lights, with controller and stand complete; electric night signalling sets, diving lamps, ventilating sets, desk and bracket fans, &c.

**London County Council.**—The Highways Committee, at a meeting of the Council on 21st inst., presented a report in relation to the proposed erection of workshop buildings adjoining the sub-station being built at Clapham in connection with the electrical operation of the tramways. On the recommendation of the Committee, it was resolved to sanction an expenditure of £3,600 for the purpose. The Council adjourned the consideration of recommendations by the Highways Committee in favour of rescinding the proposal to seek powers to construct a tramway from Battersea Park Road *vid* Battersea Bridge and Chelsea Embankment to Buckingham Palace Road, and of applying for powers to lay a tramway from Battersea Park Road *vid* Battersea Bridge to a point in Beaufort Street, near King's Road. Approval was given to plans submitted on behalf of the Central Electric Supply Co. for the erection of a building to contain water-softening plant at the company's generating station in Grove Road, St. John's Wood.

**The American Electrical Trade Outlook.**—In an editorial note on the American trade outlook, our contemporary, the *Electrical World and Engineer*, remarks:—"While the home outlook is encouraging, there would be more satisfaction in it if the beginnings made of export trade in many branches were not nipped in the bud by a prosperity which tempts the manufacturer to neglect foreign markets. That this check has been felt is not to be denied, and it implies, unfortunately, a certain amount of wasted time and effort, with the consequent difficulties of renewing broken connections and affiliations. Complaints have reached us from parties abroad with whom a start had been made, but who find now that they must wait months for apparatus, or that it is not particularly cared whether their orders are filled or not. On the contrary, we are glad to know that some manufacturers are nursing and pushing their foreign trade steadily and persistently, knowing how intrinsically valuable it is in increasing the volume of production, and in providing new outlets."

**Electrical Engineering at the Durham College of Science.**—A report has recently been presented to the President and Council of the North-East Coast Institution of Engineers and Shipbuilders by Mr John Gravell, who represents that body upon the Council of the Durham College of Science, Newcastle-upon-Tyne, which describes the work done by the latter educational establishment during the past five years. Mr. Gravell remarks that no branches of applied science have made more marked progress than electricity and engineering, and, in consequence, those departments of the College have had to be strengthened by the foundation of a Lectureship in Electrical Engineering and of a Demonstratorship in Engineering. The electrical work has proved eminently successful and highly beneficial to the district—more especially so in the case of the evening students. The demand for tuition in the laboratory has been so great during the current session—no fewer than 66 students having been in attendance—that an additional evening per week has had to be devoted to the requirements of the electrical students. The attendance at the lecture classes has been upwards of 150.

**Personal.**—On Friday last an interesting little ceremony was performed when several of the friends of Mr. Dane Sinclair foregathered to entertain that gentleman at dinner, and to present him with a souvenir of his stay among them in London. Mr. Sinclair, as our readers are aware, is now managing the business of the British Insulated and Helsby Cables Co., Ltd., at Prescot, and the warmth of his greeting on Friday last will probably long remain with him in the new field he has chosen for the display of his energetic temperament and business acumen. Mr. John Gavey took the chair at the dinner, which was held at Prince's Restaurant, Piccadilly, and in a graceful speech alluded to the negotiations in which he, on behalf of the Post Office, and the guest of the evening, on behalf of the National Telephone Co., had engaged for so long. One very important testimony to the high qualities of Mr. Sinclair was the fact that several of those with whom in days gone by he had been in opposition or competition were warmest in their encomiums of his keen sense of fairness in all his business transactions. Mr. Gavey concluded his interesting address by presenting Mr. Sinclair, on behalf of the hosts of the evening, with a silver tea and coffee service.

Mr. Ed. C. de Segundo notifies that his address in future will be 267, Dashwood House, New Broad Street, E.C., he having recently opened headquarter offices there.

The *Madras Mail* says that on October 1st Mr. Ernest Sellon, of a firm of electrical engineers in London, arrived in Madras from Bombay. He was shown over the works at the power station of the tramways company at Egmore, and was conducted over the several sections of the system in Madras, and left for Hyderabad (Deccan). Mr. Sellon is on a visit to India with a view to inspecting electric tramways in the more important cities and towns, and is equipped with the latest methods and improvements in this connection. Mr. Sellon was later to proceed to Burma, and visit Mandalay.

The King of Italy has appointed Signor Marconi to be a Chevalier of the Order of Industrial Merit.

**Trinity College, Dublin.**—The board of Trinity College are establishing a new electrical and mechanical engineering laboratory, and Mr. Tatlow, B.E., has been appointed lecturer in electrical engineering. His courses will commence early in November.

**Dinner.**—The Faraday Club have arranged for a dinner to be held at St. Ermin's Hotel, on Friday, 7th prox., at 7.30. p.m. Mr. J. Swinburne will preside. A smoking concert is to follow.

**Institution of Electrical Engineers.**—The first meeting of the 1902—1903 Session of the Institution is to be held on Thursday, November 13th, at 8 p.m. After the premiums awarded for papers read last session have been awarded, Mr. James Swinburne, the president, will deliver his inaugural address.

**Efficiency of Direct Current Motors.**—The following table, which is referred to in our leading columns to-day, is taken from Mr. Michael Longridge's report on the insurance and inspection of electrical machinery, and well illustrates the high efficiencies now obtainable in the smaller sizes of these motors:—

TESTS ON FOUR-POLE SEMI-ENCLOSED MOTORS.

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Maker's rating ... ... .. ... B.H.P. | 25 | 15 | 12 | 10 | 10 | 8 | 6 | 6 | 6 |
| 2 | " " speed ... ... ... r.p.m. | 480 | 770 | 625 | 835 | 830 | 990 | 990 | 950 | 925 |
| 3 | Electromotive force ... ... ... volts | 200 | 500 | 500 | 500 | 500 | 500 | 500 | 500 | 500 |
| 4 | Guaranteed input ... ... ... ... watts | 22,200 | 12,250 | 10,200 | 8,500 | 8,500 | 6,950 | 5,400 | 5,400 | 5,400 |
| 5 | Losses at guaranteed input ascertained by test " | 2,641 | 1,096 | 998 | 878 | 1,010 | 921 | 750 | 730 | 932 |
| 6 | Net power available from guaranteed input " | 19,559 | 11,154 | 9,202 | 7,622 | 7,490 | 6,029 | 4,650 | 4,670 | 4,468 |
| 7 | Efficiency at guaranteed input ... ... ... | 0·88 | 0·91 | 0 90 | 0·90 | 0·88 | 0·87 | 0 86 | 0·87 | 0 83 |
| 8 | Duration of trial ... ... ... ... hours | 6 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| 9 | Initial temperature ... ... deg. Fah. | 50 | 62 | 62 | 67 | 64 | 65 | 67 | 65 | 65 |
| 10 | Final temperature—magnet coils " | 120 | 109 | 118 | 110 | 111 | 100 | 92 | 98 | 102 |
| 11 | " " armature ... " | 107 | 111 | 118 | 111 | 113 | 102 | 111 | 97 | 102 |
| 12 | " " commutator... " | — | 118 | 118 | 127 | 126 | 115 | 97 | 115 | 126 |
| 13 | Resistance of armature, commutator, and brushes hot ... ... ... ... ohms | ·097 | ·57 | ·9 | 1·03 | 1·08 | 1·41 | 1·37 | 1·42 | 1 44 |
| | ANALYSIS OF LOSSES:— | | | | | | | | | |
| 14 | $C^2R$ in field coils ... ... ... ... watts | 732 | 215 | 215 | 195 | 200 | 150 | 150 | 150 | 150 |
| 15 | " armature and brushes ... ... " | 1,197 | 332 | 357 | 284 | 298 | 268 | 151 | 156 | 159 |
| 16 | Friction and eddy currents, assumed to be the same at full as at light load ... " | 712 | 549 | 424 | 399 | 512 | 503 | 449 | 424 | 623 |
| | Total, see line 5 " | 2,641 | 1 046 | 998 | 878 | 1,010 | 921 | 750 | 730 | 932 |

**Electricity in Mines.**—It is announced that the Home Secretary has appointed a committee to inquiry into the use of electricity in mines and the dangers attending it, and to report what measures should be adopted in the interests of safety, by the establishment of special rules or otherwise. The committee consists of Mr. H. H. S. Cunynghame, C.B., Legal Assistant Under-Secretary of State for the Home Department (chairman), Mr. Charles Fenwick, M.P., Mr. Archibald Hood, past-president of the Mining Association of Great Britain, Mr. James Swinburne, president of the Institution of Electrical Engineers, and Mr. W. N. Atkinson and Mr. H. Stokes, his Majesty's Inspectors of Mines. The secretary of the committee is Captain A. Desborough, one of his Majesty's Inspectors of Explosives, War Office.

**Düsseldorf Exhibition.**—Reuter reports that after defraying all expenses and erecting a permanent art gallery, the Düsseldorf Exhibition made a net profit of 1,000,000 marks, which will be devoted to public purposes in the Rhine Provinces and Westphalia. The Exhibition has been the most successful ever held in Germany.

**Municipal Trading.**—The Hon. Vicary Gibbs, M.P., a member of the Council of the Industrial Freedom League, is to read a paper on "Municipal Trading" at the annual conference of the United Property Owners' and Ratepayers' Association of Great Britain, to be held at the Westminster Palace Hotel on November 19th.

**Obituary.**—In Welsh circles great consternation was caused on Monday by the announcement of the death of Mr. Archibald Hood, chairman of the South Wales Electrical Power Distribution Co. He had only just been in consultation a day or two before with Mr. Graham Harris, the consulting engineer, with regard to new developments, and was then seemingly in his usual health.

**British Enterprise in America.**—According to the New York correspondent of the *Morning Post*, a British syndicate proposes to turn to use for industrial manufacture the heavy fall in the Potomac River, near Washington, a project which the Americans, in their anxiety for European conquests, have entirely overlooked. The syndicate, says the correspondent, has acquired all the land on both sides of the Potomac from Tide Water to Great Falls, which section of the river embraces sufficient natural power to supply the entire City of Washington with light, heat, and motive power without the consumption of a single pound of coal. Within the acquired territory are three separate falls, the first being only five miles distant from Capitol Hill. At this fall the first plant will be erected. In the course of one mile there is a total fall of 60 ft., which is held to be sufficient to operate turbine wheels with the heaviest dynamos. The plan of development involves a capital of £1,000,000, and the scheme is to be well under way before the end of the year. More than 1,000 men will be employed at the beginning, and it is the intention of the incorporators to use as far as possible only British labour.

**Announcement.**—Mr. F. H. Headley, of St. Austell, has had to take larger works in order to cope with the increased demand for his patent switches and the growth of his contracting business. He has accordingly taken a lease of Moresk Mills, Truro, where his head office and works will be in future.

**Appointment Vacant.**—An assistant engineer and chief clerk at Swindon at £100 each.

**Seeing by Wire.**—A correspondent of the *Express* states with apparent sincerity that "a new discovery of apparently remarkable value was submitted to-day to the French Academy of Sciences. It relates to the possibility of seeing the reflection of persons to whom one is talking through the telephone." Sufficient for the day is the evil thereof. It is quite enough for us to have to *hear* their reflections, let alone seeing them.

## THE CENTRAL STATION ENGINEER.

MR. W. E. MILNS, of Stamford Electricity Works, has been appointed engineer at the Grantham Electricity Works. Mr. Milns will still retain his position at Stamford, and Mr. F. B. HILLS, of Chelmsford, has been appointed his assistant at Stamford.

The salary of Mr. H. C. CARTER, chief assistant at Heckmondwike, has been increased by £20 per annum.

The Barnstaple U.D.C. has appointed Mr. J. W. HADFIELD, now acting as assistant electrical engineer to Mr. TRENTHAM at the works, to the office of electrical engineer and general manager at the electric lighting station at a salary of £180 per annum.

## NEW COMPANIES REGISTERED.

**Hudson & Bowring, Ltd.** (75,213).—This company was registered on October 24th, with a capital of £2,000 in £1 shares, to acquire and carry on the business of manufacturers of and dealers in tramway life-guards and accessories and the like now carried on by A. Hudson & J. Bowring, trading as "Hudson & Bowring," at 4, Russell Street, Manchester, and to take over in particular a patent, No. 2,448, of 1902, known as "Hudson's improved automatic life-guard." The first subscribers (each with one share) are:—A. Hudson, 18, Balmoral Street, Belle Vue, Manchester, tramway life-guard manufacturer; J. Bowring, 30, Claud Street, Crumpsall, Manchester, tramway life-guard manufacturer; L. H. Green, 8, Seymour Road, Crumpsall, Manchester, clerk; J. A. Keen, 6, Borth Avenue, Withington, Manchester, manager; C. H. Turner, 17, Church Road, Chorlton-cum-Hardy, cashier; W. Crossley, 115, Ellesmere Street, Moorside, Swinton, clerk; and F. Warburton, 12, Halliwell Lane, Cheetham, Manchester, clerk. No initial public issue. The number of directors is not to be less than three nor more than five; the first are A. Hudson, J. Bowring, C. H. Goode, W. J. Raudall and R. Campbell; qualification, 25 shares. Registered office, 1, St. James's Square, Manchester.

**Excelsior Fibre Co., Ltd** (75,176).—This company was registered on October 21st, with a capital of £10,000 in £5 shares, to carry on the business of manufacturers of paper, fibre, and fibrous substances for belting, packing, blocks, tubes, rods, roving and weft cans, pails, handles, dust bins, water pails, pans and other articles, or for electrical insulation or other purposes, and to manufacture and deal in such articles as aforesaid, including all wood, iron, metal and other work required for the same. The first subscribers (each with 10 shares) are:—W. H. Baron, Dale Bank, Bacup, cashier; C. A. Greenhalgh, Rose Hill, Bacup, dental surgeon; J. Hargreaves, Weir Terrace, Bacup, contractor; J. J. Smithies, Broomfield, Deeplish, Rochdale, iron merchant; J. W. Sutcliffe, Market Street, Bacup, joiner; A. W. Aked, Fir Trees, Bacup, chartered accountant; and R. E. Cross, 54, Deeplish Road, Rochdale, architect. No initial public issue. The first directors are W. H. Baron, C. A. Greenhalgh, J. Hargreaves, J. J. Smithies, and J. W. Sutcliffe; qualification, 50 shares. Registered office, Green End Works, Bacup.

## OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

**C. & A. Musker (1901), Ltd.** (70,573), hydraulic and electrical engineers.—Issue on October 9th of £5,000 debentures, part of a series created July 5th, 1901, to secure £50,000, charged on the company's undertaking and property, present and future, including uncalled capital. Date of trust deed: July 8th, 1901. Trustees: The Law Guarantee and Trust Society, Ltd. Total amount previously issued of same series: £26,900.

**T. C. Welding & Co., Ltd.** (70,309), manufacturers of electric fittings, &c.—Issue on October 9th of £100 debentures, part of a series created October 2nd, 1902, to secure £500, charged on the company's undertaking and property, present and future, including unpaid capital. No trustees. No previous issue of same series.

**Electric Lighting Boards, Ltd.** (64,543).—Issue on September 30th of £200 debentures, part of a series created June 5th, 1902, to secure £20,000, constituting a first and floating charge on the company's undertaking and property, present and future, including uncalled capital. Trustee: Gen. S. J. Nicholson. Total amount previously issued of same series: £19,000.

**Woking Electric Supply Co., Ltd.**—Issue on September 24th of £500 debentures (10 of £50 each), part of a series created November 2nd, 1899, to secure a total sum of £25,000, charged on the company's undertaking and property, present and future, including uncalled capital. The company may not create any mortgage or charge in priority to these debentures. No trustees. Total amount previously issued of same series: £18,150.

**Bastian Meter Co., Ltd.** (originally named "Penny-in-the-Slot" Electric Supply Syndicate, Ltd.).—Issue on October 3rd of £500 debentures (10 of £50 each), part of a series created by resolutions of April 22nd, May 23rd, and June 10th, 1901, to secure a total sum of £6,000. Property charged: Land at Kentish Town and the messuage and buildings erected thereon, known as 24, Bartholomew Villas, and all other assets of the company, present and future, including uncalled capital. Date of trust deed: December 30th, 1901. Trustees: H. A. Saunders, Chesterfield, and D. J. Cowles, Manor House, Felixstowe. Total amount previously issued of same series: £4,050.

**Electric Ozone Syndicate, Ltd.**—Issue on September 20th of £600 debentures, and on October 7th of £200 debentures, part of a series created October 16th, 1901, to secure a total sum of £6,000, charged on the company's undertaking and property, present and future, including uncalled capital. No trust deed. Total amount previously issued of same series: £4,600.

**St. Helens Cable Co., Ltd.** (62,741).—Issue on October 2nd of £10,000 second debentures (20 of £500 each), part of a series—unlimited in amount. Date of resolution authorising present issue:—September 29th, 1902. Property charged: The company's undertaking and property, present and future, including uncalled capital. Holders: W. W. Pilkington, St. Helens (£5,000); and J. Beecham, St. Helens (£5,000). No trust deed. Total amount previously issued of same series:—£124,000.

**Messrs. Rowland Barnett & Co., Ltd.** (40,774).—Electrical and mechanical engineers, electricians, &c. A debenture dated October 14th, 1902, to secure £500 and 5 per cent. interest, charged on the company's undertaking and property, present and future, has been registered. Holders: H. N. Middleton and G. Fenwick, bankers, of Newcastle-on-Tyne.

**Western Electric Railways Development Co., Ltd.** (74,733).—Issue on October 20th of £10,000 debentures (100 of £1,000 each), part of a series created on the same date to secure a total sum of £1,000. Property charged: The company's undertaking and property, present and future, including uncalled capital. No trust deed.

**South Lancashire Electric Traction and Power Co., Ltd.** (67,974).—A trust deed dated January 28th, 1901, securing £750,000 debenture stock created by resolution dated November 30th, 1900, has been registered. The deed specifically charges the company's shares in the South Lancashire Tramways Co., and the Lancashire Light Railways Co., Ltd.; also (as a floating security) the other assets of the company, present and future, including uncalled capital. The company also covenants to assure to the trustees and charges any after-acquired lands or hereditaments. Trustees: Sir W. B. Forwood, Bromborough Hall, Ches.; and W. S. Barrett, J.P., Abbottsgate, Huyton, Lancashire.

**T. Emlyn Jones, Ltd.** (72,526).—Ironmongers, electricians and engineers.—Issue on October 17th of £2,000 debentures, part of a series created same date to secure £4,000, charged on the company's undertaking and property, present and future, including uncalled capital (if any). No trustees.

**United Kingdom Tramway, Light Railway and Electrical Syndicate, Ltd.** (62,387.)—A mortgage, dated October 20th, 1902, stamped to cover £4,800, created to secure liabilities now or hereafter incurred by mortgagees on behalf of syndicate, including £300 advanced, has been registered. Property charged: 4s. 6d. per share uncalled on 6,630 shares, and all Parliamentary deposits, moneys, rights and general property except uncalled capital and except chattels within the meaning of the Bills of Sale Acts. Mortgagees: Major H. Tulloch and J. Parnell.

**Middleton Electric Traction Co., Ltd.** (63,935.)—A trust deed, dated October 16th, 1902, to secure £50,000 debenture stock, has been registered. Property charged: the company's assets, present and future. Trustees: the Electric and General Investment Co., Ltd., 1—2, Great Winchester Street, E.C.

## CITY NOTES.

### Western Telegraph Co., Ltd.

The report of the directors for the half-year ended June 30th, 1902, read as follows:—

The revenue for this period amounted to £213,269 0s. 8d. and the working expenses to £82,468 3s. 6d. After providing £12,677 4s. 0d. for debenture interest and sinking fund, and £4,119 16s. 6d. for income-tax, there remains a balance of £113,993 16s. 8d.; to this is added the sum of £5,531 1s. 6d. brought forward from December 31st last, making a total of £119,524 18s. 2d. A quarterly interim dividend, amounting to £31,189 10s. 0d., has been paid, £30,000 transferred to the General Reserve Fund, and £2,000 to the Maintenance Ships' Reserve Fund. The directors now recommend the declaration of a final dividend of 3s. per share, making, with the interim dividends, a total dividend of 6 per cent. for the year, and also the payment of a bonus of 2s. per share, both free of income-tax, which together will amount to £51,982 10s. 0d., leaving a balance of £4,352 18s. 2d. to be carried forward.

Sir John Wolfe Barry, K.C.B. (chairman), presided on Wednesday morning at River Plate House over the fifty-eighth ordinary general meeting of the above company, and, in moving the adoption of the report, first referred to the retirement of Mr. W. S. Andrews from the chairmanship of the company. The board had accepted the retirement with great reluctance, but it was gratifying to think that Mr. Andrews would still retain his seat on the board, and they would have the benefit of his experience and advice. There was nothing very startling in the report, but it was, on the whole, satisfactory as showing that the business was going on in a proper manner, and perhaps it was better to have a report which contained nothing of a startling character. At the same time they would have noticed that the whole of the report was not altogether so satisfactory as it had been on former occasions. There was a decrease in the message receipts of nearly £16,800. On the other side of the account the dividends on investments had been increased by £1,500, and there was a net decrease of receipts of £15,600. There was not a net decrease of returns because they happened to have had a considerable decrease in the expenditure. The reason of the decrease in the message receipts was that they were still working under some of the adverse conditions which prevailed when the shareholders last met. The tariff had been considerably reduced, and, in comparison with the corresponding period of last year, was lower. That diminution of tariff accounted for something like a third of the decrease in message receipts. It was, however, a satisfactory thing to know that although the decrease had taken place, there were evident signs of an increase in the bulk of the traffic transmitted which would, he thought, before long go far towards recouping the decrease in the tariff. General business in South Africa was still on a smaller scale than in 1900 and in the early part of 1901, and the company, like all commercial enterprises, felt the effect of buoyant or non-buoyant business as soon as anybody. Another reason for the diminution was that the Brazilian rate of exchange had been almost stationary, although that meant fewer messages to Europe, still it was really a satisfactory feature, for it showed there was a more permanent state of affairs in Brazil which would tend to a larger commercial prosperity. With regard to the expenditure in London, there had been a slight increase of £275, and in other places there had been six increases and six decreases. At the stations there were seven items showing increases, the largest being the cost of the maintenance of landlines and electrical apparatus. They had 10 accounts showing decreases, the principal one being travelling expenses of staff, &c. On the whole, at the stations there was an increase of about £500. The repairs to cables and maintenance of ships amounted to £17,486, as against £42,000 in the December half, being a decrease of the very considerable sum of £24,600. Of this decrease £9,000 was because they had had fewer chartered steamers, and about £13,000 was owing to less cable being expended in repairs. He felt bound, however, to say that he felt that the debit for cables was abnormally low for the half-year, and must not be considered as their regular liability. In the other expenses there was an increase of about £1,600 for the use of patents and maintenance of electrical instruments, &c. The board wished to use for the benefit of the public any patent or improvement which would give greater certainty and greater speed and produce better results, for they felt that whatever was good for the customers was good for the shareholders. They had also spent £2,400 on the instalment of electric light at their three principal stations. The expenses of the removal of the head office—£1,250—was an item not likely to occur again. The net result of the whole of these matters was that there was a decrease in the working expenses of £18,500, and after providing for debenture interest and sinking fund and income-tax, there remained a balance of £113,993, to which had to be added £5,531 from last December, making a total of £119,524. The quarterly interim dividend had been paid, and £30,000 transferred to general reserve, and £2,000 to the maintenance of ships reserve fund. They recommended the declaration of a final dividend of 3s per share, making, with the interim dividends, a total dividend of 6 per cent. for the year, and also the payment of a bonus of 2s. per share, which would leave a balance of £4,352 to be carried forward. With regard to wireless telegraphy, they had installed this at Porthcurno. The object was to allow the company to experiment for itself as to the possibilities of wireless telegraphy, and also to enable them to intercept their ships on their homeward journey if they were wanted to return to make repairs in the Bay of Biscay and other places, and so save time and coal. They believed that, under certain conditions of the atmosphere, it would be possible to communicate with ships 80 or 100 miles away. The system adopted was that of Maskelyne's, which followed the general line of Marconi's, but was claimed to be an improvement in several respects. Their ships had not yet been fitted, but incidentally they had received various messages at Porthcurno, evidently not intended for them. The record was somewhat interesting, and occasionally somewhat amusing. So far as the commercial value of wireless telegraphy was concerned, the experience gained clearly indicated, so far as they could judge, that it was not likely to be a rival to cable enterprises.

Sir J. Denison Pender seconded the motion, and the report was adopted.

### Norwich Electric Tramways Co.

The sixth annual meeting was held in London on October 21st. The report presented (for a copy of which we are indebted to an Ipswich newspaper), stated that the gross earnings of the company during the 11 months ended July, 1902, amounted to £29,897, and the working expenses to £21,371, leaving a gross profit of £8,525. To that amount should be added £704, brought forward from last year, and £48 interest on loans, which made a total of £9,278. Deducting from that the sum of £2,640, being 4 per cent. interest on the company's outstanding mortgage debentures to June 30th, 1902,

there remains a profit of £6,638. The directors recommended the payment of a dividend of 2 per cent. on the company's shares, which would absorb £4,840, leaving 974 to be placed to the reserve account, and £824 to be carried forward to next year. The unsatisfactory earnings of the tramways for the part year were to be accounted for by the unfavourable weather during the entire spring and early summer, and by the condition of the City of Norwich, which was suffering from financial depression, caused partly by the war and partly by bad business. Although the gross receipts were lower by £2,516 than those for the same period last year, the working expenses were higher by £966. It was satisfactory to find that the average cost per car-mile, which last year amounted to 5·91d., had been reduced to 5·51d., and that compared favourably with the other tramways in England. The average receipts per car-mile were 7·71d., and the number of car miles run was 930,678, the number of passengers carried being 6,383,391.—The report was adopted.

## Monte Video Telephone Co.

The report for the year ended July 31st last, presented at the meeting held on the 30th inst., shows a net profit of £11,142, after providing for all working expenses in Monte Video and London. To this amount should be added the sum of £1,064 brought forward from last year, leaving an available balance of £12,206. From this sum the directors propose to transfer £5,000 to reserve fund, and they recommend that, after payment of the full dividend at the rate of 5 per cent. per annum upon the preference shares, a dividend at the rate of 2½ per cent. per annum be paid upon the ordinary shares and that the balance of £1,064 be carried forward.

## Cuba Submarine Telegraph Co., Ltd.

Mr. Charles W. Parish, who presided at the meeting of this company on October 22nd, said that the traffic receipts for the six months were £12,784, as compared with £9,981 in the corresponding period of 1901, or an increase of £2,803; but the comparative statement of traffic showed that £1,662 of that increase was earned in the month of May, when the terrible disasters befell Martinique and St. Vincent, which caused such a loss of life and property. As was to be expected Press messages were then exceedingly large. The item of £1,892 interest and dividends on investments and deposits was rather less than last year, but taking the traffic receipts and that item together, they had earned £14,682, against £12,007 in 1901, or an increase of £2,675, which he thought on the whole satisfactory. The expenditure had been £5,788 this half year as compared with £5,519 in the same period of 1901. Taking the difference into account, they had earned £8,894 net profit in the first half of 1902, as compared with £6,488 in the corresponding period. From the profits they had been able to place £2,752 to reserve, and the preference dividend at the rate of 10 per cent required £3,000, and they recommended a dividend on the ordinary shares at the rate of 4 per cent. per annum. They would then carry forward £4,532, as compared with £4,590. In examining their expenditure they would be struck with the singularly little difference between the two half years. They had written off rather more under the head of depreciation of stores and cable stock which was naturally a varying item. When he last addressed them he stated that the item of the cost of repairing the Cape Cruz—Santiago cable was from £6,000 to £7,000, but the actual cost was £5,752, which had been paid out of the reserve fund. He was glad they had been able to replace £2,752 of the amount from the profits of the half-year. Those who were old shareholders knew that they attached the greatest importance to keeping up their reserve fund as much as possible, considering that each year their cables were growing older and the terms of their concessions were running out. The reserve fund now stood at £129,000 as against £132,000 of June 30th, 1901. The £3000 having gone towards the cost of the Cape Cruz—Santiago cable. They would also notice that £8,174 which they claimed from the United States Government for damage done to their cables during the war was still unsettled. The Foreign Office had again communicated with the British Ambassador on the matter, and the board continued to hope that Congress would recognise their claim in a friendly manner. He must say, however, that the board were very much annoyed that they had been unable to get that money. On May 20th the American Government handed over the Island of Cuba to the New Government, and since then the administration of the island had been in the hands of the local Government. Their legal representatives at Havana had been instructed to apply for the subsidy due for the coast cables since January, 1899, and they trusted that the amount would be paid. As regarded their lawsuit with the West India and Panama Co. they would see that the House of Lords dismissed the appeal of their opponents with costs and confirmed the judgment of Mr. Justice Farwell. It had been a long and tiresome case, and he took that opportunity of complimenting and thanking their secretary, Mr. Scott, for the intelligent manner in which he collected the mass of evidence which had arisen from time to time since the foundation of their company 30 years ago. He felt that Mr. Scott had very largely assisted their legal advisers to form an appreciation of the wording of the original contracts which led to the dispute. They were now adjusting with the West India and Panama Co. the accounts for the past four and a half years on the basis of the judgment given in their favour, and the next half year's account would include the amount they would receive in settlement of their claim. In conclusion, the chairman referred to the unfortunate state of the sugar industry which had caused great depression in the Island of Cuba, but said there seemed some signs of improvement, and if the United States would relieve the situation as was expected by a reduction of the import duty on cane sugar, there might before long be a general revival of business, and he hoped that would bring increased traffic to their line.

Mr. George Keith seconded the motion, which was adopted.

## The British Thomson-Houston Co., Ltd.

The directors' report submitted to, and passed by, the meeting held on Thursday, October 23rd, reads:—

Directors:—W. A. McArthur, Esq., M.P. (chairman); Gen. Eugene Griffin (vice-chairman); C. Burrell, Esq.; E. A. Carolan, Esq.; C. A. Coffin, Esq.; G. Franklin, Esq.; S. Kocherthaler, Esq.; H. C. Levis, Esq. (managing director); J. F. Nauheim, Esq.: E. W. Rice, Jr., Esq.; O. H. Smith, Esq.; E. Thurnauer, Esq.; and Sir Thos. R. Thompson, Bart.

*Works at Rugby.*—The works, as originally planned, were completed during the year. An additional building for stores, and manufacturing purposes is now approaching completion, and will add greatly to the capacity of the works, though it is probable that a further increase will be required in the near future. The company is now employing at Rugby a considerable number of hands, and a large amount of work is in progress.

*Great Northern and City Railway.*—The contract for all of the electrical apparatus in connection with this undertaking was some time since awarded to the company. The work has progressed rapidly, and the installation is approaching completion.

*Hamilton, Motherwell and Wishaw Tramways.*—The work in connection with this enterprise is well under way, and your directors believe it will prove a profitable undertaking for the company.

*Chatham and District Light Railway.*—The work under this contract has been completed. The line was open for traffic on June 17th last, and so far has given satisfactory results.

*Other enterprises.*—Your directors believe the company has good value in the other enterprises in which it has investments, and are satisfied with their conditions and prospects.

The profits, after deducting general and technical expenses, discounts and interest, amount to £60,587 18s. 10d., of which sum £31,275 10s. 4d. has been applied as shown in the profit and loss account. The profit and loss account has been necessarily affected by the expenditure on the Rugby works of considerable sums, on which it has not yet been possible to earn profits. The available balance after adding thereto the sum of £1,157 7s. 7d. brought forward March 31st, 1901, is £30,469 16s. 1d., which the directors recommend be distributed as follows:—

| | | | |
|---|---|---|---|
| £3,650 | 15 | 7 | to dividend accrued June 30th, 1902, on £400,000 4 per cent. cumulative preference shares in respect of which £300,000 has been called and paid from time to time. |
| 20,000 | 0 | 0 | to dividend at the rate of 4 per cent. per annum for 15 months on £400,000 ordinary shares fully paid. |
| 3,059 | 8 | 0 | to reserve, being 5 per cent. of £60,587 18s. 10d. |
| 3,759 | 12 | 6 | to profit and loss new account. |
| £30,469 | 16 | 1 | |

The directors recommend that the dividend on the ordinary shares be paid on October 24th next. The half-yearly dividend calculated to August 5th last, at the rate of 4 per cent. per annum on the cumulative preference shares as called and paid from time to time will also be paid on October 24th, and in future half-yearly on February 5th and August 5th in each year. In consequence of changes in the proprietary of the company there have been changes in the composition of the board. Six of your directors, viz.:—Messrs. E. A. Lazarus, W. J. Clark, J. Hamspohn, I. Loewe, Dr. J. T. Merz, and A. R. Monks, have resigned their seats on the board, and four of the vacancies thus created have been filled by Messrs. E. A. Carolan, S. Kocherthaler, H. C. Levis, and O. H. Smith. Messrs. G. Franklin, J. F. Nauheim, E. Thurnauer, and Sir Thomas R. Thompson, Bart., are the directors who retire by rotation, and are eligible for re-election. The auditors, Messrs. Price, Waterhouse & Co., retire and are eligible for re-election.

## Brockie-Pell Arc Lamp, Ltd.

The second annual report of the directors, to be presented at the meeting to be held at 60, Worship Street, E.C., on Wednesday, November 5th, at 12.30 p.m., reads as follows:—

The directors have pleasure in submitting herewith the profit and loss account and balance sheet for the year ending June 30th, 1902. This shows that after writing off £629 0s. 4d. depreciation on plant, machinery and tools, &c. (against £435 17s. 11d. written off in the previous year), there remains a net profit on the year's trading of £2,232 14s. This added to the amounts brought forward from last year makes a total of £4698 2s. 7d. for disposal. Out of this sum the directors propose to write off the remainder of the reconstruction expenses, £344 10s., and recommend the payment of a dividend of 3 per cent., amounting to £2,392 10s. 7d., thus leaving a balance of £1,961 2s. to be carried forward. The company's business has shown a considerable increase during the year, the sales of lamps and accessories being 40 per cent. in excess of those for the preceding period. On the other hand, owing to severe competition on the part of rival manufacturers, the prices obtained have not been so favourable, and the profits have therefore been smaller in proportion. In order to meet this competition the directors have now introduced a cheaper form of their standard lamps, which is enabling them to secure profitable orders which they have hitherto been unable to obtain on account of price. The contract for the lighting of the Glasgow Exhibition has been satisfactorily completed, and a large number of lamps employed therein have been sold. The directors have also undertaken the lighting of the present Exhibition at Wolverhampton, and 250 of the company's lamps are now in use for that purpose. Among other important orders which have been executed during the year may be mentioned those for lamps for street and tramway lighting in Westminster, Edinburgh, Stirling, Manchester, Salford, and Bournemouth. Since the conclusion of the war several important orders have been received from South Africa, and there is every reason to expect a steady development of this branch of the company's business. The remaining 1s. per share has been called, and duly paid up, in accordance with the notification contained in last year's report, and has enabled the directors to pay off the mortgage debenture of £2,000. In accordance with the Articles of Association, the Hon. R. Brougham retires, and being eligible offers himself for re-election. The auditors, Messrs. Mellois, Basden & Co., also retire, and being eligible, offer themselves for re-election.

## Cape Electric Tramways, Ltd.

The report for the year ended June 30th last, to be presented at the meeting on the 12th prox., states that the profit and loss account on the 12 months' working, after provision for debenture interest and redemption of debentures, shows a net balance to credit of £81,948, which, added to the balance of £15,341 brought forward, makes a gross total profit of £96,840. From this sum the directors have paid to the shareholders 18 per cent. upon their

capital, represented by three interim dividends. The directors have also placed to the credit of the reserve fund £8,000. These several sums aggregate a gross total of £80,800, and leave £16,040 to be carried forward. From this sum, however, provision has to be made for the remuneration of directors and auditors. A sum of £40,000 2¾ per cent. Consols has been purchased at a cost of £37,841 from the special reserve fund of £56,000. The report for the year ended June, 1901, showed a very gratifying increase in the business over previous years, and this increase of traffic has still further developed, both in Cape Town and Port Elizabeth, during the past year. After many unavoidable, though vexatious delays, owing to the abnormal condition of business in Cape Town, the enlargement of the power station, the erection of additional engine and boilers, the enlargement of the car-shed necessary for the additional cars (now added to the rolling stock in Cape Town) have all approached final completion, and already some of the new cars are in active operation. The extension from Port Elizabeth to Humewood, referred to in the last report submitted, has now been completed, and will be opened for traffic during the month. The Bill for the electrification of the Sea Point Railway, after having been drafted for submission to Parliament, was afterwards withdrawn owing to the opposition of the municipality of Cape Town, which endeavoured to embody certain clauses which, with every desire to meet that body, it was impossible for the board to accept. The appeal which was lodged before the Privy Council by the Eastern Telegraph Co. against the decision given in the company's favour by the Supreme Court in Cape Town, in the question of the suit brought against the company by the Telegraph Company claiming damages for £50,000 alleged to have been caused to their cable service by the working of the tramways, was heard on April 16th last, and unanimously given in the company's favour. This decision has finally put an end to prolonged litigation, and may be regarded as of the greatest importance as being likely to form a precedent for the settlement of future litigation of an analogous character. The extension to the Cape Town docks has not yet been put in hand owing to further disagreements which have arisen between the Cape Town Municipality and the Harbour Board, without whose joint co-operation, together with that of the Cape Government Railway, the line cannot be constructed. On January 25th last the directors authorised an issue of a further 40,000 ordinary shares of the company at 37s. 6d. per share, being at a premium of 17s. 6d. per share. This issue, as in the case of the previous one, was made to the shareholders *pro rata* to their holding.

---

**Prospectus.**—The list closed yesterday in an issue of 19,500 £5 preference shares (6 per cent.) in the Burmah Electric Tramways and Lighting Co, Ltd., for which Messrs. Kincaid, Waller, Manville & Dawson are the engineers. The company is to carry into effect a Mandalay electric tramways concession for 7 miles of double line, and perhaps later on electric lighting powers as well. The only public conveyances at present available are gharries or cabs which are said to earn from £40,000 to £50,000 per annum. The electric lines have to be completed by December, 1904. The concession is held by the Burmah Electric Works Syndicate, whose shares are owned by the Burmah Tramways Construction Co., the promoters of the present company. The new company will pay the Construction Co. £100,000 in cash and 20,000 fully paid ordinary shares of £5 each, and will take over the tramways in full working order. Messrs. Dick, Kerr & Co. are to carry out the work. The preference shares are now offered on behalf of the Construction Co. The company's offices are at Worcester House, Walbrook, E.C.

**Bath Electric Tramways Co.**—Sir Vincent Caillard presiding at the statutory meeting held at 78, St. Helen's Place, E.C., on 21st inst., said that they had been slightly delayed in making a start with the work of construction, but everything was now practically ready to commence. It was really in the public interest that they had delayed starting the permanent way, but the steel rails were being rolled, and should be delivered within a few days. To complete the works additional capital would be required, and it was possible, as the public did not to any great extent respond to the invitation to apply for shares, that more debentures might be issued than was at first contemplated.

**Stock Exchange Notices.**—Applications have been made to the Committee to appoint a special settling day in, and to grant a quotation to—British Insulated Wire Co., Ltd., further issue of £250,000 4½ per cent. first mortgage debenture stock. British Thomson-Houston Co., Ltd., £200,000 4½ per cent. first mortgage debenture stock. Bromley (Kent) Electric Light and Power Co., Ltd., £50,000 4½ per cent. first debenture stock. The Committee has ordered the undermentioned security to be quoted in the Official List:—Colombo Electric Tramways and Lighting Co., Ltd., £120,000 5 per cent. first mortgage debenture stock.

**Newcastle Electric Supply Co.**—A few weeks ago this company issued 20,000 new ordinary £5 shares and 20,000 new preference £5 shares, making a total increase in capital of £200,000. The whole of this amount was not fully taken up by the shareholders, and they have the option of making a further application for the remainder until to-day.

**Callender's Cable and Construction Co.**—The directors have resolved to pay on November 1st an interim dividend of 5s. per share to the holders of ordinary shares Nos. 1 to 30,000 and Nos. 40,001 to 45,000.

**Castner-Kellner Alkali Co.**—The directors have declared an interim dividend at the rate of 6 per cent. per annum for the six months ended September 30th last.

## STOCKS AND SHARES.

Wednesday Evening.

Talk of dearer money is the latest bugbear started in the Stock Exchange, and although it is somewhat difficult to see what definite grounds there can be for the apprehension, it has entered into the current factors which make the markets. Towards the end of the year it is, of course, quite usual for rates to harden slightly in Lombard Street, if only by reason of the window-dressing beloved by banks and other financial institutions at the turn of every six months. But the present 4 per cent. Bank Rate is admittedly ineffective, and while there is little chance of a reduction on this side of the New Year, there is, on the other hand, no present prospect of a further rise taking place.

Consols keep dull under these circumstances, and the faint spurt which occurred at the end of last week was rapidly neutralised by heavy sales of stock. Still, the markets with which we have to deal are in a healthy condition, and again the rises out-number the declines. Paramount amongst the changes stands out a dramatic jump in Commercial Cable stock, and the excitement in regard to London's subterranean communication is giving rise to a series of sharp fluctuations in the stocks of existing "Tubes." The electrical supply list is steady, without important variation, and in miscellaneous issues there is a recision to record in both classes of British Electric Traction shares.

With the prospect of the London County Council becoming a competitor in the ranks of electric railways, there has come a shake out in both District and Metropolitan stocks, from the idea that if the L.C.C. obtains power for running a system beneath the Embankment, the business of the two other companies will be severely trenched upon. Districts at 37¼ and Metropolitan at 82½ show falls of 1⅛ and ⅜ respectively. Central London is unaffected by the latest proposals, and the company's securities are hard at their enhanced values. City and South London rose a point upon the traffic of the Royal Progress week. The final call of £2 per share is being made upon the Preference and the Ordinary shares of the Baker Street and Waterloo Railway. This will make them £10 paid, and possibly some sort of market may be started in the shares. At present there is none. It is stated that Bills are being prepared for Parliament for the construction of mono-rail lines from London to Brighton and Dover, and already particulars of the Brighton Electric Railway (Preliminary) Syndicate are being widely circulated.

Prospectuses are beginning to make their appearance more rapidly, and amongst the latest appellants for capital is the Burmah Electric Tramways and Lighting Co., Ltd. Some 19,000 6 per cent. Preference shares of £5 each are offered, the Construction Co. guaranteeing the dividend on the shares now offered until December 6th, 1904. A study of the prospectus makes it clear that the concern is more or less of an experimental nature, and while it appears respectable enough, the shares hardly hold out any great attraction to the average investor.

Eighteen points rise in Commercial Cable sounds more sensational than it really is, for the price has been marked up with scarcely any stock changing hands. There is much more business doing in Anglo-American Telegraph issues, all of which show substantial improvements on the week, the Preferred stock being particularly in request, although the Deferred is also being largely bought by the speculatively-inclined. It is thought that the company will be able to make up the Preferred dividend in full next quarter. Great Northern and Telegraph shares have weakened a trifle, while West African Telegraphs display a 10s. fall, on account of the exceeding slackness prevailing in the Jungle market.

The demand for City of London Electric Lighting issues has manifested itself in the Preference shares this week, and a rise of ½ is the result. South Londons are also harder, but these improvements find counteraction in declines of ½ in St. James's and ¼ in Edmundson's. Beyond a local demand in the North for Newcastle-on-Tyne Electric Lighting shares, there is not much doing amongst provincial descriptions. The Newcastle Co. is making a fresh issue of shares.

British Electric Traction shares, as mentioned in the introductory paragraph, are rather easier on a few selling orders, but the excellent report of the Calcutta Tramways sent in buyers of those shares, and the Ordinary are 7½, the Preference being 4½. The Debenture stock changed hands a day or two ago at 107. Perth Electric Tramways (W.A.) 5 per cent Debenture has been sold at 102¾ this week. Anglo-Argentine Trams are 4½, and the Debenture stock 127½.

Brockie-Pell Arc Lamp shareholders are to receive a 3 per cent. dividend, which is at all events better than nothing; the price of the shares is nominally about 5s. 6d., but there is hardly any market in them. Castner-Kellner at ¾ show no change, and Electrolytic Alkali are ½ lower than Castners. General Electric Debenture has dropped a point. The telephone market is uninteresting, and shows no fluctuation on the week.

# SHARE LIST OF ELECTRICAL COMPANIES.

## TELEGRAPH AND TELEPHONE COMPANIES.

| Present Issue. | NAME. | Stock or Share. ‡ | Dividends for the last three years. 1899. | 1900. | 1901. | Closing Quotations Oct. 22nd. | Closing Quotations Oct. 29th. | Business done week ended Oct. 29th, 1902. Highest | Lowest. |
|---|---|---|---|---|---|---|---|---|---|
| 67,100 | African Direct Telegraph, 4 % Debs. | 100 | .. | .. | .. | 98 —102 | 98 —102 | .. | .. |
| 25,000 | Amazon Telegraph Co.'s shares, Nos. 1 to 25,000 | 10 | .. | .. | .. | 3½ — 4½ | 3½ — 4½ | .. | .. |
| 119,700£ | Do. do. 5 % Debs., Nos. 1 to 1,250 Red. | 100 | .. | .. | .. | 70 — 80 | 70 — 80 | .. | .. |
| 788,840 | Anglo-American Telegraph | Stock | 73/6 | 3½% | 61s. | 48 — 51 xd | 50 — 53 | .. | .. |
| 3,105,580 | Do. do. do. 6 % Pref. | Stock | 6 % | 6 % | 6 % | 91 — 93 | 94 — 96 | 93⅝ | 92⅝ |
| 3,105,580 | Do. do. do. Deferred | Stock | £1 7s. | 5s. % | 2s. | 7½ — 8 | 8½ — 9½ | 8 1/16 | 7 15/16 |
| 44,000 | Chili Telephone, Nos. 1 to 44,000 | 5 | 4 % | 5 % | 5 % | 3½ — 4½ | 3½ — 4½ | .. | .. |
| 18,333,300$ | Commercial Cable | $100 | 8 % | 8 % | 8 % | 160 —170 xd | 178 —188 | .. | .. |
| 1,841,209 | Do. do. Sterling 500 year 4 % Deb. Stock Red. | Stock | .. | .. | .. | 94 — 96 | 94 — 96 | 95½ | .. |
| 16,000 | Cuba Telegraph | 10 | 7 % | 4½% | 4 % | 5½ — 6½ | 5½ — 6½ | .. | .. |
| 6,000 | Do. 10 % Pref. | 10 | .. | .. | .. | 13 — 14 | 13 — 14 | .. | .. |
| 12,931 | Direct Spanish Telegraph | 5 | 4 % | 4 % | 4 % | 2½ — 3½ | 2½ — 3½ | .. | .. |
| 6,000 | Do. do. 10 % Cum. Pref. | 5 | .. | .. | .. | 7 — 8 | 7 — 8 | .. | .. |
| 60,710£ | Direct United States Cable | 20 | 3½% | 3½% | 3½% | 10½ — 11 xd | 10½ — 11 | 10⅞ | .. |
| 96,300 | Direct West India Cable, 4½ % Reg. Deb., within Nos. 1 to 1,200, Red. | 100 | .. | .. | .. | 100 —103 | 100 —103 | .. | .. |
| 4,000,000 | Eastern Telegraph, Ord. Stock | Stock | 7 % | 7 % | 7 % | 124 —129 xd | 124 —129 | 126½ | 124 |
| 1,955,565 | Do. 3½ % Pref. Stock | 100 | .. | .. | .. | 89 — 92 | 89 — 92 | 91½ | 90½ |
| 1,534,645 | Do. 4 % Mort. Deb. Stock Red. | Stock | .. | .. | .. | 106 —109 | 106 —109 | 106⅝ | .. |
| 300,000 | Eastern Extension, Australasia, and China Telegraph | 10 | 7 % | 7 % | 7 % | 12 — 12½ xd | 12 — 12½ | 12⅝ | 12 1/16 |
| 320,000£ | Do. 4 % Deb. Stock | Stock | .. | .. | .. | 107 —110 | 107 —110 | .. | .. |
| 300,000 | Eastern & South African Tele., 4% Mt. Db., Nos. 1 to 3,000, red. 1909 | 100 | 5¼% | .. | .. | 99 —102 | 99 —102 | .. | .. |
| 200,000£ | Do. do. 4 % Reg. Mort. Debs. (Mauritius Sub.) 1 to 8,000 | 25 | .. | .. | .. | 101 —104 % | 101 —104 % | 102⅜ | .. |
| 180,227 | Globe Telegraph and Trust | 10 | 5¼% | 5¼% | 5¼% | 9½ — 10 | 9½ — 10 | 9⅝ | .. |
| 180,042 | Do. do. 6 % Pref. | 10 | .. | .. | .. | 13½ — 14 | 13½ — 14 | 13¾ | 13½ |
| 150,000 | Great Northern Telegraph, of Copenhagen | 10 | 12½% | 15 % | 15 % | 27 — 28 | 27½ — 28½ | .. | .. |
| 70,000 | Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red. | 100 | .. | .. | .. | 100 —103 | 100 —103 | .. | .. |
| 17,000 | Indo-European Telegraph | 25 | 10 % | 10 % | 10 % | 38 — 42 | 39 — 40 | .. | .. |
| 100,000£ | London Platino-Brazilian Telegraph, 6 % Debs. | 100 | .. | .. | .. | 101 —105 | 101 —105 | .. | .. |
| 72,680 | Montevideo Telephone, Ltd., Ord. Nos. 1 to 72,680 | 1 | 2½% | .. | .. | ¼ — ⅜ | ¼ — ⅜ | .. | .. |
| 86,492 | Do. do. 5 % Pref., Nos. 1 to 86,492 | 1 | 5 % | .. | .. | ¼ — 1 | ¼ — 1 | .. | .. |
| 1,983,333 | National Telephone, Pref. Stock | 100 | 5 % | 5 % | 5 % | 93 — 95 | 93 — 95 | 94 | 93 |
| 1,966,667 | Do. do. Def. Stock | 100 | .. | 60 | 64 xd | 56 — 58 | 56 — 58 | 57½ | 56 |
| 15,000 | Do. do. 6 % Cum. 1st Pref. | 10 | 6 % | 6 % | 6 % | 12¼ — 13¼ | 12¼ — 13¼ | .. | .. |
| 15,000 | Do. do. 6 % Cum. 2nd Pref. | 10 | 6 % | 6 % | 6 % | 11½ — 12½ | 11½ — 12½ | .. | .. |
| 250,000 | Do. do. 5 % Non-cum. 3rd. Pref., 1 to 250,000 | 5 | 5 % | 5 % | 5 % | 4½ — 5⅛ | 4½ — 5⅛ | .. | .. |
| 2,000,000£ | Do. do. 3½ % Deb. Stock Red. | Stock | 3½% | 3½% | 3½% | 96 — 99 | 96 — 99 | 97 | 96 |
| 600,000 | Do. do. 4 % Deb. Stock Red. | 100 | .. | 4 % | 4 % | 102 —106 | 102 —106 | 103½ | 102 |
| 171,504 | Oriental Telephone and Elec. Nos. 1 to 171,504, fully paid | 1 | 5 % | 6 % | 6 % | ⅞ — 1 | ⅞ — 1 | .. | .. |
| 100,000£ | Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000 | 100 | .. | .. | .. | 99 —102 | 99 —102 | .. | .. |
| 11,839 | Reuter's | 8 | 5 % | 5 % | 5 % | 6½ — 7½ xd | 6½ — 7½ | .. | .. |
| 3,308 | Submarine Cables Trust | Cert. | .. | .. | .. | 110 —120 | 110 —120 | .. | .. |
| 58,000 | United River Plate Telephone | 5 | 7 % | 7 % | 7 % | 4⅜ — 5¼ | 4⅜ — 5¼ | .. | .. |
| 40,000 | Do. do. 5 % Cum. Pref., Nos. 1 to 40,000 | 5 | .. | .. | .. | 4½ — 5 | 4½ — 5 | .. | .. |
| 179,947£ | Do. do. 5 % Debs. | Stock | .. | .. | .. | 102 —105 | 102 —105 | .. | .. |
| 15,609 | West African Telegraph, Shares | 10 | .. | .. | .. | 3½ — 4½ | 3½ — 4½ | 3⅝ | .. |
| 30,008 | West Coast of America, Nos. 1 to 30,000 and 53,001 to 53,008 | 2½ | .. | .. | .. | 0 — ¼ | 0 — ¼ | .. | .. |
| 150,000£ | Do. do. 4% Debs., 1 to 1,500 guar. by Bras. Sub. Tel. | 100 | .. | .. | .. | 98 —101 | 98 —101 | .. | .. |
| 267,930 | Western Telegraph, Ltd., Nos. 1 to 207,930 | 10 | 7 % | 7 % | 7 % | 11⅞ — 12¼ | 11⅞ — 12¼ | 12⅛ | 12 |
| 75,000£ | Do. do. 5 % Debs. 2nd series, 1906 | 100 | .. | .. | .. | 102 —105 | 102 —105 | .. | .. |
| 400,000 | Do. do. 4 % Deb. Stock Red. | 100 | .. | .. | .. | 99 —102 | 99 —102 | .. | .. |
| 88,321 | West India and Panama Telegraph | 10 | 2½% | 1¼% | .. | ⅛ — ⅜ | ⅛ — ⅜ | ⅜ | .. |
| 34,563 | Do. do. do. 6 % Cum. 1st Pref. | 10 | .. | .. | .. | 4½ — 5 | 4½ — 5 | .. | .. |
| 4,669 | Do. do. do. 6 % Cum. 2nd Pref. | 10 | .. | .. | .. | 3 — 4 | 3 — 4 | .. | .. |
| 80,000£ | Do. do. do. 5 % Debs., Nos. 1 to 1,800 | 100 | .. | .. | .. | 100 — 103 | 100 —103 | .. | .. |

## ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 20,000 | British Aluminium 7 % Cum. Pref. | 10 | .. | 5¼% | .. | 3½ — 3¾ | 3½ — 4½ | .. | .. |
| 300,000£ | Do. do. 5% 1st Mort. Deb. Stock Red. | Stock | .. | .. | .. | 83 — 88 | 83 — 88 | .. | .. |
| 100,000 | British Electric Traction | 10 | 8 % | 9 % | 9 % | 13 — 14 | 13 — 13½ | 13⅜ | 13 |
| 100,000 | Do. do. 6 % Cum. Pref. | 10 | .. | .. | .. | 12½ — 13 | 12½ — 12⅝ | 12⅝ | 12⅝ |
| 600,000£ | Do. do. 5 % Perpetual Debenture Stock | Stock | .. | .. | .. | 124 —127 | 124 —127 | 125 | .. |
| 100,000 | British Insulated Wire Ord. | 5 | 20 % | 15 % | 10 % | 7⅞ — 8⅛ | 7⅞ — 8⅛ | .. | .. |
| 100,000 | Do. do. 6 % Cum. Pref. | 5 | .. | .. | .. | 5⅞ — 6 | 5⅞ — 6 | .. | .. |
| 50,000 | Do. do. 4½ % 1st Mort. Deb. Red. | 100 | .. | .. | .. | 103 —106 | 103 —106 | 104⅞ | 104⅝ |
| 50,000 | ¶Browett, Lindley & Co. (1899), Ord. | £1 | .. | 8 % | .. | 13s. to 15s. | 13s. to 15s. | .. | .. |
| 50,000 | ¶ Do. do. 6 % Cum. Pref. | £1 | .. | 6 % | .. | 16s. to 16/6 | 16s. to 16/6 | .. | .. |
| 105,731 | Brush Electrical Engineering, Ord., 1 to 105,731 | 2 | 5½% | 5 % | Nil | 1 — 1¼ | ¾ — 1¼ | 1 1/16 | .. |
| 150,000 | Do. do. Non-cum. 6 % Pref. | 2 | 6 % | 6 % | 3 % | 1¼ — 1⅜ | 1 — 1⅜ | .. | .. |
| 125,000£ | Do. do. 4½ % Perp. Deb. Stock | Stock | .. | .. | .. | 100 —103 | 100 —103 | .. | .. |
| 125,000£ | Do. do. 4½ % Perp. 2nd Deb. Stock | Stock | .. | .. | .. | 93 — 98 | 94 — 99 | .. | .. |
| 35,000 | Callender's Cable Construction shares | 5 | 15 % | 15 % | 20 % | 15½ — 16½ | 15½ — 16½ | .. | .. |
| 40,000 | Do. do. do. 5 % Cum. Pref. | 5 | .. | .. | .. | 5½ — 6½ | 5½ — 6½ | 5⅞ | .. |
| 90,000£ | Do. do. do. 4½ % 1st Mort. Deb. Stock Red. | Stock | .. | .. | .. | 109 —113 | 109 —113 | .. | .. |
| 1,860,014 | Central London Railway, Ord. Stock | Stock | .. | .. | 4 % | 108 —111 | 108 —111 | 109 | 108½ |
| 494,093 | Do. do. 4 % Pref. Stock | Stock | .. | .. | 4 % | 107 —110 | 107 —110 | 109½ | 108 |
| 494,993 | Do. do. Def. do. | Stock | .. | .. | 4 % | 108 —111 | 108 —111 | 108¾ | 108¼ |
| 1,330,000 | City and South London Railway | Stock | 1¼% | 1¼% | 2 % | 71 — 73 | 71 — 73 | 74 | 73 |
| 85,000 | Crompton & Co., Nos. 1 to 85,000 | 3 | 7½% | 8 % | 7½% | 2¾ — 2⅞ | 2¾ — 2⅞ | 2 1/16 | .. |
| 100,000£ | Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 red. | .. | .. | .. | .. | 101 —106 % | 101 —106 % | .. | .. |
| 99,261 | Edison & Swan United Elec. Light, "A" shares, £3 paid, 1 to 99,261 | 5 | 6 % | 2½% | .. | ⅛ — ¼ | ⅛ — ¼ | .. | .. |
| 17,139 | Do. do. "A" shares, 01—017,139 | 5 | 6 % | 2½% | .. | 1¾ — 2¼ | 1¾ — 2¼ | .. | .. |
| 344,023£ | Do. do. 4 % Deb. Stock Red. | 100 | .. | .. | .. | 74 — 78 | 74 — 78 | .. | .. |
| 100,000£ | Do. do. 5 % 2nd Deb. Stock Prov. Certs. all pd. | 100 | .. | .. | .. | 77 — 82 | 77 — 82 | 79 | 78 |
| 112,100 | Electric Construction, 1 to 112,100 | 2 | 6 % | 6 % | 6 % | 1¾ — 2 | 1¾ — 2 | .. | .. |
| 31,390 | Do. do. 7 % Cum. Pref., 1 to 31,390 | 2 | .. | .. | .. | 2¼ — 2⅜ | 2¼ — 2⅜ | .. | .. |
| 182,500£ | Do. do. 4 % Perp. 1st Mort. Deb. Stock | Stock | .. | .. | .. | 99 —102 | 99 —102 | .. | .. |
| 25,000 | General Electric Co. (1900), 5 % Cum. Pref. | 10 | .. | 5 % | 5 % | 10 — 10⅛ | 10 — 10⅛ | .. | .. |
| 200,000 | Do. do. 4 % Mort. Deb. | Stock | .. | .. | .. | 100 —103 | 99 —102 | .. | .. |
| 35,000 | Henley's (W. T.) Telegraph Works, Ord. | 5 | 15 % | 20 % | 20 % | 16 — 17 | 16 — 17 | .. | .. |
| 35,000 | Do. do. 4½ % Pref. | 5 | 4½% | 4½% | .. | 5⅛ — 5⅜ | 5⅛ — 5⅜ | .. | .. |
| 48,050 | Do. do. 4½ Mort. Deb. Stock | Stock | .. | .. | .. | 100 —113 | 100 —113 | .. | .. |
| 50,000 | India-Rubber, Gutta-Percha & Telegraph Works | 10 | 10 % | 10 % | .. | 20½ — 21½ | 20½ — 21½ | 21⅛ | .. |
| 300,000£ | Do. do. do. 4 % 1st Mort. Deb. | 100 | .. | .. | .. | 99 —102 | 99 —102 | .. | .. |
| 37,500 | †Liverpool Overhead Railway, Ord. | 10 | 3½% | 3½% | 1½% | 4⅛ — 5⅛ | 4⅛ — 5 | .. | .. |
| 10,000 | † Do. do. Pref. £10 paid | 10 | 5 % | .. | .. | 10 — 10½ | 10 — 10½ | .. | .. |
| 7,500 | Parker (Thomas), Ltd., Ord., Nos. 1 to 7,500 | 10 | .. | .. | .. | 14½ — 15½ | 14½ — 15½ | .. | .. |
| | §Rosling & Fynn 6 % Cum. Pref. | £1 | .. | 6 % | .. | .. — .. | 19/0 to 20/0 | .. | .. |
| 37,350 | Telegraph Construction and Maintenance | 12 | 15 % | 17½% | 20 % | 37 — 40 | 37 — 40 | 39½ | .. |
| 150,000£ | Do. do. 4 % Deb. Bds., Nos. 1 to 1,500 Red. 1909 | 100 | .. | .. | .. | 102 —105 | 102 —105 | .. | .. |
| 540,000£ | Waterloo & City Railway, Ord. Stock | 100 | 3 % | 3 % | 3 % | 91 — 94 | 90 — 93 | .. | .. |

† Quotations on Liverpool Stock Exchange.
§ From Bradford Share List.
‡ Unless otherwise stated all shares are fully paid.
¶ From Manchester Share List.

## LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

Consolidated Telephone Construction and Maintenance, 7/16—7/8.
National Electric Free Wiring, ¾—1.

Oldham, Ashton, and Hyde Electric (£10 pd.), Ord., 13—14.
Do. do. Pref. (£10 pd.), 10—11

**Bank rate of discount 4 per cent. (October 2nd, 1902).**

## SHARE LIST OF ELECTRICAL COMPANIES (*continued*).—ELECTRICITY SUPPLY COMPANIES.

| Present issue. | NAME. | Stock or Share. | Dividends for the last three years. 1899. | 1900. | 1901. | Closing Quotations Oct 22nd. | Closing Quotations Oct. 29th. | Business done week ended Oct. 29th, 1902. Highest. | Lowest. |
|---|---|---|---|---|---|---|---|---|---|
| 100,000 | Blackheath and Greenwich Dist. Electric Light, Ord. | ‡ £1 | .. | .. | .. | ⅜ — ⅝ | ⅜ — ⅝ | .. | .. |
| 100,000 | Do. 4½% 1st Deb. Stock, Prov. Certs. | 100 | .. | .. | .. | 105 —108 | 105 —108 | .. | .. |
| 20,000 | Brompton & Kensington Electric Light Sup., Ord., 1 to 20,000 | 5 | 6 % | 6 % | 8 % | 10½ — 10⅝ | 10½ — 10⅝ | 10⅝ | .. |
| 20,000 | Do. do. 7 % Cum. Pref. | 5 | .. | .. | .. | 10½ — 10⅝ | 10½ — 10⅝ | 10½ | .. |
| 50,000 | Charing Cross and Strand Electricity Supply | 5 | 9 % | 9 % | 10 % | 9 — 9⅛ | 9 — 9⅛ | .. | .. |
| 70,000 | Do. do. do. 4½% Cum. Pref. | 5 | .. | .. | .. | 5⅛ — 6 | 5⅛ — 6 | .. | .. |
| 40,000 | Do. do. "City Undertaking" 4½% Cum. Pref. | 5 | .. | .. | .. | 4⅞ — 5⅛ | 4⅞ — 5⅛ | .. | .. |
| 250,000 | Do. do. 4 % Deb. Stock Red. | 100 | .. | .. | .. | 105 —107 | 105 —107 | .. | .. |
| 44,436 | * ea Electricity Supply, Ord. | 5* | 6 % | 5½% | 4 % | 5½ — 6 | 5½ — 6 | .. | .. |
| 150,000‡ | Do. do. % Deb. Stock Red. | Stock | .. | .. | .. | 109 —112 | 109 —112 | .. | .. |
| 70,595 | City o London Electric Lighting, Ord. 40,001—110,595 | 10 | 4 % | 0 % | 5 % | 10 — 11 | 10 — 11 | 10⅜ | .. |
| 40,000 | Do. 6 % Cum. Pref., 1 to 40,000 | 10 | 6 % | 6 % | .. | 13 — 14 | 13½ — 14½ | .. | .. |
| 400,000 | Do. 5 % Deb. Stock, Scrip. (iss. at 115) all paid | .. | .. | .. | .. | 123 —128 | 123 —128 | .. | .. |
| 3)),0 | Do. 4½% 2nd Deb. Stock, Prov. Certs., all paid | 100 | .. | .. | .. | 104 —107 | 104 —107 | 106½ | 106 |
| 40,000 | County of London & Brush Prov. Electric Lighting, Ord. 1—40,000 | 10 | 4 % | 4 % | 4 % | 8½ — 9⅛ | 8½ — 9⅛ | .. | .. |
| 20,000 | Do. do. do. 6 % Pref., 40,001—60,000 | 10 | 6 % | 6 % | .. | 11⅛ — 12⅛ | 11⅛ — 12⅛ | 12⅛ | .. |
| 400,000‡ | Do. do. 4½% Deb. Stock, Prov. Certs. (all paid) Red | .. | .. | .. | .. | 110 —113 | 110 —113 | 111⅛ | 111½ |
| 50,000 | Edmundson's Electric Corporation, Ord. Shares | 5 | 6 % | 7 % | 7 % | 6⅛ — 6⅝ | 6 — 6⅛ | 6 1/16 | 6⅛ |
| 30,000 | Do. do. 6 % Cum. Pref. | .. | .. | .. | .. | 6 — 6⅛ | 6 — 6⅛ | .. | .. |
| 140,000 | Do. do. 4½% 1st Mort. Deb. Stock | 100 | .. | .. | .. | 107 —110 | 107 —110 | 108½ | .. |
| 21,000 | Kensington and Knightsbridge Electric, Ord. | 5 | 11 % | 12 % | 10 % | 10 — 11 | 10 — 11 | .. | .. |
| 90,000 | Do. do. do. 4 % Debenture Stock | Stock | .. | .. | .. | 101 —104 | 101 —104 | .. | .. |
| 110,000 | ondon Electric Supply Corporation, Limited, Ord. | 3 | .. | .. | .. | 1⅝ — 2⅛ | 1⅝ — 2⅛ | .. | .. |
| 49,840 | Do. do. do. 6 % Pref. | 5 | .. | .. | .. | 4⅜ — 5⅛ | 4⅜ — 5⅛ | .. | .. |
| 250,000‡ | Do. do. do. 4 % 1st Mort. Deb. Stock Red | Stock | .. | .. | .. | 96 — 99 | 96 — 99 | 97⅜ | .. |
| 100,000 | M.—ropolitan Electric Supply, 1 to 100,000 | 10 | 5 % | 6 % | 6⅜% | 15⅛ — 16⅛ | 15⅛ — 16⅛ | 16⅛ | 16 1/16 |
| 220,000‡ | Do. do. 4½% 1st Mort. Deb. Stock | .. | .. | .. | .. | 110 —115 | 110 —115 | .. | .. |
| 250,000‡ | Do. do. 3½% Mort. Deb. Stock Red | Stock | .. | .. | .. | 99 —102 | 99 —102 | .. | .. |
| 10,852 | Notting Hill Electric Lighting | 10 | 7 % | 7 % | 6 % | 13⅜ — 14⅜ | 13⅜ — 14⅜ | .. | .. |
| 40,000 | St. James' and Pall Mall Electric Light, Ord. | 5 | 14½% | 14½% | 14½% | 15 — 16 | 14⅜ — 15⅜ | 15⅜ | .. |
| 20,000 | Do. do. do. 7 % Pref. 20,081 to 40,080 | 5 | 7 % | 7 % | 7 % | 8¾ — 9⅛ | 8⅝ — 9⅛ | .. | .. |
| 150,000‡ | Do. do. do. 3½% Deb. Stock Red | 100 | .. | .. | .. | 98 —101 | 98 —101 | .. | .. |
| 12,000 | Smithfield Markets Electric Supply, Ord. | 5 | .. | .. | .. | 1⅞ — 2⅛ | 1⅞ — 2⅛ | .. | .. |
| 50,000‡ | Do. do. 4% Deb. | 100 | .. | .. | .. | 80 — 90 | 80 — 90 | .. | .. |
| 65,000 | South London Electricity Supply, Ord. | 5 | .. | .. | .. | 2⅜ — 3 | 2⅜ — 3⅛ | 2 15/16 | .. |
| 110,000 | Westminster Electric Supply, Ord. | 5 | 13 % | 10½% | 10½% | 11⅛ — 12⅛ | 11⅛ — 12⅛ | 12 1/16 | .. |
| 28,141 | Do. do. 5 % Cum. Pref. | 5 | .. | .. | .. | 6 — 6⅛ | 6 — 6⅛ | 6⅛ | 6⅛ |

* Subject to Founders Shares. ‡ Unless otherwise stated all shares are fully paid.

## MARKET QUOTATIONS, Wednesday, October 29th

| CHEMICALS, &c. | | This week. | Last week. | Inc. or Dec. |
|---|---|---|---|---|
| a Acid, Hydrochloric | per cwt. | 5/- | 5/- | .. |
| a ,, Nitric | per cwt. | 22/- | 22/- | .. |
| a ,, Oxalic | per cwt. | 32/- | 32/- | .. |
| a ,, Sulphuric | per cwt. | 5/6 | 5/6 | .. |
| a Ammoniac, Sal | per cwt. | 42/- | 42/- | .. |
| a Ammonia, Muriate (crystal) | per ton | £33 10 | £33 10 | .. |
| a ,, ,, | per ton | £30 | £30 | .. |
| a Bleaching powder | per ton | £4 10 | £4 10 | .. |
| a Bisulphide of Carbon | per ton | £15 | £15 | .. |
| a Borax | per ton | £13 | £13 | .. |
| a Bensole (90%) | per gal. | 7/- | 7/- | .. |
| a ,, (50/90%) | per gal. | 5/6 | 5/6 | .. |
| a Copper Sulphate | per ton | £19 | £19 | .. |
| a Lead, Nitrate | per ton | £24 | £24 | .. |
| a ,, White Sugar | per ton | £31 | £31 | .. |
| a ,, Peroxide | per ton | £27 10 | £27 10 | .. |
| a Methylated Spirit | per gal. | 2/6 | 2/6 | .. |
| a Naphtha, Solvent (90% at 160° C). | per gal. | 5/6 | 5/6 | .. |
| a Potash, Bichromate, in casks | per lb. | 8½ | 8½ | .. |
| a ,, Caustic (75/80%) | per ton | £24 | £24 | .. |
| a ,, Bisulphate | per ton | £35 | £35 | .. |
| a Shellac | per cwt. | 130/- | 109/- | 21s. inc. |
| a Sulphate of Magnesia | per ton | £4 10 | £4 10 | .. |
| a Sulphur, Sublimed Flowers | per ton | £6 5 | £6 5 | .. |
| a ,, Recovered | per ton | £5 10 | £5 10 | .. |
| a ,, Lump | per ton | £5 | £5 | .. |
| a Soda, Caustic (white 70%) | per ton | £10 15 | £10 15 | .. |
| a ,, Crystals | per ton | £3 | £3 | .. |
| a ,, Bichromate, casks | per lb. | 2½d. | 2½d. | .. |

| METALS, &c. | | | | |
|---|---|---|---|---|
| b Aluminium Ingots, in ton lots | per ton | £148 | £148 | .. |
| b ,, Wire, in ton lots | per ton | £224 | £224 | .. |
| b ,, Sheet, in ton lots | per ton | £191 | £191 | .. |
| p Babbitt's metal ingots | per ton | £40 to £140 | £40 to £140 | .. |
| c Brass (rolled metal 2" to 12") basis | per lb. | 6¾d. | 6¾d. | .. |
| c ,, Tube (brazed) | per lb. | 8¼d. | 8¼d. | .. |
| c ,, ,, (solid drawn) | per lb. | 7d. | 7d. | .. |
| c ,, Wire, basis | per lb. | 7d. | 7d. | .. |
| c Copper Tubes (brazed) | per lb. | 8¾d. | 8¾d. | .. |
| c ,, ,, (solid drawn) | per lb. | 9d. | 9d. | .. |
| g Copper Bars (best selected | per ton | £67 | £67 | .. |

| METALS, &c. (*continu* | | This week. | Last week. | Inc. or Dec. |
|---|---|---|---|---|
| g Copper Sheet | per ton | £67 | £67 | .. |
| g ,, Rod | per ton | £67 | £67 | .. |
| e ,, (Electrolytic) Bars | per ton | £65 | £65 | .. |
| e ,, ,, Sheets | per ton | £74 | £74 | .. |
| e ,, ,, Rod | per ton | £65 | £65 | .. |
| e ,, ,, H.C. Wire | per lb. | 7¼d. | 7¼d. | .. |
| f Ebonite Rod | per lb. | 3/- | 3/- | .. |
| f ,, Sheet | per lb. | 5/- | 5/- | .. |
| n German Silver Wire | per lb. | 1/4½ | 1/4½ | .. |
| h Gutta-percha fine | per lb. | 8/- | 8/- | .. |
| h India-rubber, Para fine | per lb. | 3/1 to 3/4 | 3/1 to 3/2½ | inc. |
| i Iron, Charcoal Sheets | per ton | £18 | £18 | .. |
| i ,, Pig (Cleveland warrants) | per ton | 52/0½ | 53/1½ | 1s. 1d. dec. |
| i ,, Forgings, according to size | per ton | From £11 | From £11 | .. |
| i ,, Scrap, heavy | per ton | 47/6 to 50/- | 47/6 to 50/- | .. |
| i ,, Wire, galvanised No. 8 | per ton | £9 15 | £9 15 | .. |
| g Lead, English Ingot | per ton | £10 17 6 to £11 | £10 17 6 to £11 | .. |
| g ,, ,, Sheet | per ton | £13 | £13 | .. |
| m Manganin Wire No. 28 | per lb. | 8/- | 8/- | .. |
| g Mercury | per bot. | £8 15 | £8 15 | .. |
| d Mica (in original cases) small | per lb. | 3d. to 9d. | 3d. to 9d. | .. |
| d ,, ,, ,, medium | per lb. | 1/9 to 2/9 | 1/9 to 2/9 | .. |
| d ,, ,, ,, large | per lb. | 3/3 to 7/3 | 3/3 to 7/3 | .. |
| d ,, ,, ,, | per lb. | 11½d. to 1/2 | 11½d. to 1/2 | .. |
| p Phosphor Bronze, plain castings | per lb. | 1/- to 1/3 | 1/- to 1/3 | .. |
| p ,, ,, rolled bars & rods | per lb. | From 1/2 | From 1/2 | .. |
| p ,, ,, strip & sheet | per lb. | From £15 to £40 | | .. |
| o Platinum | per oz. | £4 | £4 | .. |
| p Silicium Bronze Wire | per lb. | 9d. to 1/- | 9d. to 1/- | .. |
| i Stee, Magnet, acc'd'g to desc'p'n | per ton | £58 | £58 | .. |
| i ,, ,, in bars | | £120 10 to £121 10 | £120 to £121 | 10s. inc. |
| g Tin, Block | per ton | 1/6 | 1/6 | .. |
| g ,, Foil | per lb. | 1/6½ | 1/6½ | .. |
| n ,, Wire, Nos. 1 to 16 | per lb. | | | .. |
| p White Anti-friction Metals— "White Ant" brand | per ton | £36 to £60 | £36 to £60 | .. |
| j Yarns, 2/10s Grey Cotton, on sp'ls | per lb. | 7d. | 7d. | .. |
| j ,, 6 lea. Flax | per lb. | 5⅜d. | 5⅜d. | .. |
| j ,, 3 ply 10 lbs. Russian | per lb. | 4 1/16d. | 4 1/16d. | .. |
| j ,, 10 lbs. Russian, single | per lb. | 4⅞d. | 4⅞d. | .. |
| j ,, 180 lbs. Jute rove | per ton | £11 11 | £11 11 | .. |
| k Zinc, Sh't (Vieille Montagne bnd.) | per ton | £23 | £23 | .. |

Quotations supplied by { a Messrs. G. Boor & Co. b The British Aluminium Co., Ltd. c Messrs. Thos. Bolton & Sons., Ltd. d Messrs. F. Wiggins & Sons. e Messrs. Frederick Smith & Co.

Quotations supplied by { f India-Rubber, G.P. and Teleg. Works g Messrs. James & Shakspeare. [Co., Ltd. h Messrs. Edward Till & Co. i Messrs. Bolling & Lowe. j Messrs. Walter H. Hindley & Co., Ltd.

Quotations supplied by { k Messrs. Morris Ashby, Limited. m Messrs. W. T. Glover & Co., Ltd. n Messrs. P. Ormiston & Sons. o Messrs. Johnson, Matthey & Co., Ltd. p The Phosphor Bronze Company, Ltd.

## TRAFFIC RECEIPTS.

| Company. | Week ending | Receipts for the week. Am'nt. | Inc. or dec.* | Total to date. Am'nt. | Inc. or dec.* | Miles open. This year. | Last year. |
|---|---|---|---|---|---|---|---|
| Blackburn Corp. Trys. | Oct. 25 | £ 784 | £ + 48 | £ 22,244 | £ + 3,607 | 12¾ | 13¼ |
| Blackpool and Fleetwood | ,, 25 | 265 | + 21 | 19,127 | — 286 | 7¾ | 7¾ |
| Bristol Trys. & Car. Co. | ,, 24 | 4,465 | +569 | — | — | 28 | 28 |
| British Elec. Trac. Co.:— | | | | | | | |
| Devonport | ,, 17 | 480 | +170 | 18,110 | + 1,062 | 5 | 5 |
| Dudley—Stourbridge | ,, 17 | 764 | + 46 | 31,554 | + 3,881 | 18½ | 18½ |
| Gateshead | ,, 17 | 274 | +272 | 31,471 | + 5,843 | 10½ | 9½ |
| Gravesend—Northfleet | ,, 17 | 210 | — | 2,413 | — | 2½ | — |
| Greenock—Pt. Glasgow | ,, 17 | 507 | +150 | 21.167 | +12,567 | 7¼ | 7¼ |
| Hartlepool | ,, 17 | 220 | — 12 | 10,736 | + 1,108 | 6¼ | 4¼ |
| Kidderminster | ,, 17 | 117 | — 2 | 5,283 | + 29 | 4½ | 4½ |
| Merthyr | ,, 17 | 190 | — 53 | 8,460 | — 1,569 | 3 | 3 |
| Middleton | ,, 17 | 247 | — | 9,107 | — | 8½ | — |
| Oldham—Ashton | ,, 17 | 563 | + 49 | 24,262 | + 1,165 | 8 | 8 |
| Poole | ,, 17 | 247 | — 7 | 10,989 | — 181 | 3½ | 3½ |
| Potteries | ,, 17 | 1,707 | +279 | 61,745 | + 2,994 | 28½ | 28½ |
| Rothesay | ,, 17 | 61 | + 24 | 1,596 | + 508 | — | — |
| B.E.T. Co. (*continued*)— | | | | | | | |
| Southport | Oct. 17 | 234 | + 78 | 10,919 | + 3,833 | 52 | 52 |
| South Staffordshire | ,, 17 | 765 | — 81 | 81,807 | — 885 | 21½ | 22½ |
| Swansea | ,, 17 | 472 | + 16 | 19,913 | + 1,272 | 5½ | 5½ |
| Taunton | ,, 17 | 56 | — 19 | 2,777 | — 301 | 1½ | — |
| Tynemouth | ,, 17 | 280 | + 92 | 12,702 | + 1,678 | 3½ | 3½ |
| Weston-super-Mare | ,, 15 | 62 | — | 5,241 | — | 2½ | — |
| Wolverhampton Dist. | ,, 17 | 311 | +188 | 8,551 | + 5,561 | 10½ | 9½ |
| Central London Railway | ,, 25 | 7,248 | +630 | 109,910 | + 9,536 | 6 | 6 |
| City and S. London Ry. | ,, 26 | 3,757 | +1,674 | 49,657 | +17,102 | 6¼ | 4¼ |
| Doncaster Corp. Trys. | Sept. 27 | — | — | 1,546 | — | 5½ | — |
| Dover Corporation Trys. | Oct. 25 | 201 | — 8 | 9,613 | + 49 | 3 | 3 |
| Dublin United Trys. | ,, 24 | 4,417 | +227 | 81,235 | + 1,502 | 46 | 46 |
| East Ham Tramways | ,, 25 | 480 | +151 | 9,510 | + 1,727 | 5 | 4½ |
| Glasgow Corp. Trys. | ,, 18 | 14,600 | —967 | 214,117 | —11,646 | 57½ | 48 |
| Liverpool Overhead Ry. | ,, 26 | 1,541 | + 97 | 26,841 | — 1,049 | 6½ | 6½ |
| Newcastle Corp. Trys. | ,, 25 | 3,080 | — | — | — | 35 | — |
| Sunderland Corp. Trys. | ,, 26 | 1,096 | + 47 | 36,567 | + 2,653 | 17½ | 17½ |

* Compared with the corresponding period of 1901.

## BRITISH ASSOCIATION, BELFAST, 1902.

### RECENT PROGRESS IN LARGE GAS ENGINES.

By Herbert A. Humphrey, M.I.Mech.E., A.M.I.C.E., M.I.E.E.

*(Abstract of Paper read before Section G, September 11th.)*

*(Continued from page 720.)*

The Cockerill Co. are now making double-action gas engines of 600, 1,200, and 1,800 H.P., the last size being for dynamo driving.

We come now to the Körting engine, made by the Gebr. Körting, the Maschinenbau Actien-Gesellschaft, of Dahlbruch, and others.

Fig. 6 is a diagram specially prepared to show all the connections in a simple manner, and to make clear the method in which the governor operates the by-pass on the gas pump.

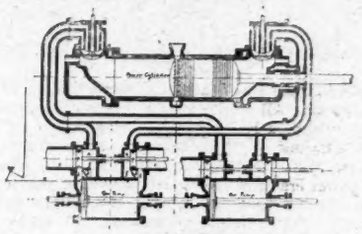


Fig. 6.

The view shows a section through the motor cylinder and the two pump cylinders, one of which supplies air and the other gas. The length of the piston is practically half the length of the motor cylinder, and the exhaust port is at the centre of the latter, and is uncovered when the piston is at either end of its stroke. Following the exhaust comes a scavenging charge of air from the air pump, which sweeps out the burnt products, and finally there enters a mixture of gas and air together. The fixture passes a diaphragm, which gives it a whirling motion, and makes it act like a plug; it being maintained that the mixture remains at the back end of the cylinder with the pure air in front next the piston. On the return stroke the piston closes the exhaust port, and compression takes place; then the mixture is fired, and the working stroke results. Both sides of the piston are utilised, and thus two impulses per revolution are obtained, and the crank effort approaches in evenness the turning moment of a double-acting steam engine. Indeed, in some ways it resembles a steam engine using gas, and the speed can be regulated by simply opening or closing the gas valve. In practice the mixture is regulated by the governor acting on a by-pass in the gas suction, in such manner that more or less gas is returned to the gas pipe, and only a portion of the pump volume delivered into the motor cylinder, according to the work to be done. The piston is water-cooled, as well as the jacket and valves.

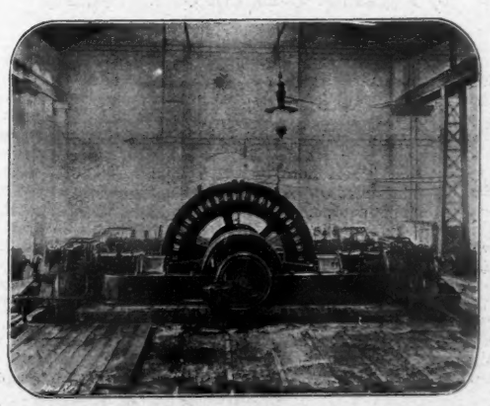


Fig. 7.

One 700-H.P. and one 500-H.P. engine are on order for this country, and will be worked with Mond gas. Both engines are for dynamo driving.

Table III. is a table of comparison of different types of engines, showing the advantage obtained by using a double-acting engine of the Körting type as compared with Otto cycle engines. Three engines of approximately the same power are compared as to size of cylinders, stroke, weight, and cyclic speed variation.

A larger number of gas engines of medium size have been turned out by the Gasmotoren-Fabrik Deutz than any other Continental firm, and now they are well in evidence with some fine examples of large engines.

One firm alone, the Gutehoffnungshütte für Bergbau und Hüttenbetrieb, of Oberhausen, has been supplied with eight Deutz engines varying in size from 300 to 1,000 H.P., and aggregating 2,400 H.P. besides three smaller engines. Another firm, the Eisenhütte-Actien Verein, Düdelingen, has two 1,000 and two 600-H.P. engines, giving 3,200 H.P. for the four engines.

Fig. 7 is a photograph of one of a pair of 1,200-H.P. gas-driven alternators, which are working in parallel at the Hörder Bergwerks-und-Hütten-Actien-Verein, in Hörde (Westfalen). The alternator shown is by Schuckert & Co., of Nürnberg.

Table III.—*Comparison of Various Types of Gas Engines.*

| Type of engine. | Number of cylinders. | Diameter of cylinders. | Stroke. | Maximum horse-power. | Weight without fly-wheel, in kilogrammes. | Weight with fly-wheel in kilogrammes. | Revolutions per minute. | Cyclical variations. |
|---|---|---|---|---|---|---|---|---|
| | | mm | mm | | | | | |
| Cockerill engine, single-cylinder "Otto" cycle .. | 1 | 1,800 | 400 | 600 | 94,000 | 127,000 | 90 | 1 : 80 |
| Deutz engines, four-cylinders "Otto" cycle .. .. | 4 | 660 | 850 | 600 | 8[illegible] | 100,000 | 150 | 1 : 120 |
| Körting engine, single-cylinder double-acting. .. | 1 | 685 | 1,100 | 550 | 000 | 70,000 | 100 | 1 |

The Oechelhäuser gas engine is in the hands of the Deutsche Kraftgas Gesellschaft, a combination of the firms of Siemens and Halske, Actien-Gesellschaft, and Union Elektricitäts-Gesellschaft, of Berlin. Various firms are building Oechelhäuser engines for the above, and their names, and those of foreign licensees, will be found in Table IV., which is a tabulated list of makers of large gas engines, and shows what powerful interests are now engaged in the new department of engineering.

Fig. 8 shows the arrangement of the two pistons working in one cylinder and attached to opposite cranks, the one directly and the

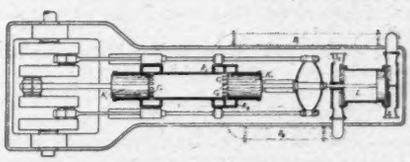


Fig. 8.

other through side rods; also the gas and air pump attached by a rod to the back piston.

Where alternators of great power are to be driven, an arrangement is adopted which results in a combination giving two impulses per revolution, very suitable for use when alternators are required to run in parallel. A 1,000-H.P. engine of this type, running at 125 revolutions per minute, only requires a 23-ton fly-wheel to limit its cyclic variation to $\frac{1}{120}$. Nearly 80 per cent. of all the Oechelhäuser engines made are for dynamo driving.

Table IV.—*Makers of Large Gas Engines.*

*"Simplex" Engines:—*
- Société Anonyme John Cockerill, of Seraing.
- Richardsons, Westgarth & Co., Ltd., Middlesbrough.
- Schneider & Co., Creusot, France.
- La Société Alsacienne de Constructions-Mecaniques, Mulhouse, Germany.
- Markische Maschinenbau Anstalt, Wetter-a-d-Ruhr, Germany.
- La Société Anonyme de Construction de Machines Breitfeld, Danek and Co., Prague, Austria.

*Körting Engine:—*
- Gebr. Körting, Körtingsdorf, near Hannover.
- The Maschinenbau Aktien-Gesellschaft, formerly Gebr. Klein, in Dahlbruch.
- Haniel & Lueg, Düsseldorf, Grafenberg.
- Siegener Maschinenbau Aktien-Gesellschaft, formerly A. and H. Oechelhäuser, Siegen.
- Donnersmarckhütte Oberschlesische Eisen-und-Kohlenwerke Aktien-Gesellschaft, Zabrze, O-S.
- Ganz & Co., Eisengiesserei-und-Maschinenfabrik Aktien-Gesellschaft, Budapest.
- Aktien-Gesellschaft der Maschinenfabriken von Escher, Wyss and Co., Zürich.
- Fichet & Heurtey, Ingenieurs des Arts et Manufactures, Paris.
- Fraser & Chalmers, Ltd., Erith, Kent.
- Mather & Platt, Ltd., Salford Iron Works, Manchester.
- The de la Vergne Refrigeratiog Machine Co., foot of East 138th Street, New York, U.S.A.

*Oechelhäuser Engine:—*
- The Deutsche Kraftgas Gesellschaft, Berlin.
- Die Berlin Anhaltische Maschinenbau-Aktien-Gesellschaft, in Dessau.
- Die Aschersiebener Maschinenbau Aktien-Gesellschaft, formerly W. Schmidt & Co., in Aschersleben.
- A. Borsig, in Tegel, near Berlin.
- Die Kölnische Maschinenbau Aktien-Gesellschaft, in Köln, Bayenthal.
- Die Siegener Maschinenbau Aktien-Gesellschaft, formerly A. and H. Oechelhäuser, in Siegen-i-Westf.

*Oechelhäuser Engine (continued)*—
L'Energie par le Gaz (Société Anonyme).
Maschinenfabrik Andritz Aktien-Gesellschaft, Andritz-Wein, Austria.
Maschinenfabrik von L. Lang, in Budapest, Hungary.
Russische Electricitäts Gesellschaft "Union," St. Petersburg, Russia.
Russische Electrotechnische Werke, Siemens & Halske Aktien-Gesellschaft, St. Petersburg, Russia.
*Deutz Engine:*—
Gas Motoren-Fabrik Deutz, Cologne.
"*Premier*" *Engine:*—
"Premier" Gas Engine Co., Sandiacre, Nottingham.
*Crossley "Otto":*—
Crossley Bros., Openshaw, Manchester.
*Westinghouse:*—
The British Westinghouse Manufacturing Co., London.
The Westinghouse Machine and Manufacturing Co., East Pittsburg, U.S.A.
*The Snow Engine:*—
The Snow Steam Pump Works, Buffalo, New York, U.S.A.
"*Stockport*" *Engine:*—
Andrew & Co., Reddish, near Stockport.
*Campbell Engine:*—
The Campbell Gas Engine Co., Halifax.
*Charon Engine:*—
Société Générale des Industries Economiques, Paris.
*Letombe Engine:*—
Compagnie de Fives Lille, Lille, France.
*Suisse:*—
Schweizerische Machinen Fabrik, Winterthur, Suisse
*Tangye Engine:*—
Tangyes, Ltd., Cornwall Works, Birmingham.
*Fielding Engine:*—
Fielding & Platt, Gloucester.
*French "Otto":*—
Cie Française des Moteurs à Gaz, Paris.
"*National*" *Engine:*—
National Gas Engine Co., Ashton-under-Lyne, Manchester.
"*Nürnberg*" *Engine:*—
Vereingte Maschinenfabrik Augsburg und Machinenbau Gesellschaft, Nürnberg.
'*Soest*" *Engine:*—
Louis Soest & Co, Reisholz, Düsseldorf.

The Westinghouse Machine and Manufacturing Co., of East Pittsburg, U.S.A, have spent much time and money in order to bring the usefulness of the large gas engine up to the standard of the large steam engine. The benefit of this experience will be reaped by the British Westinghouse Electric and Manufacturing Co., which has a fully-equipped department for the construction of large gas engines at Manchester. Most of the Westinghouse machines are of the three-cylinder vertical enclosed type.

Fig. 9 shows the largest of the Westinghouse vertical gas engines. It gives 1,000 B.H.P. with natural gas.

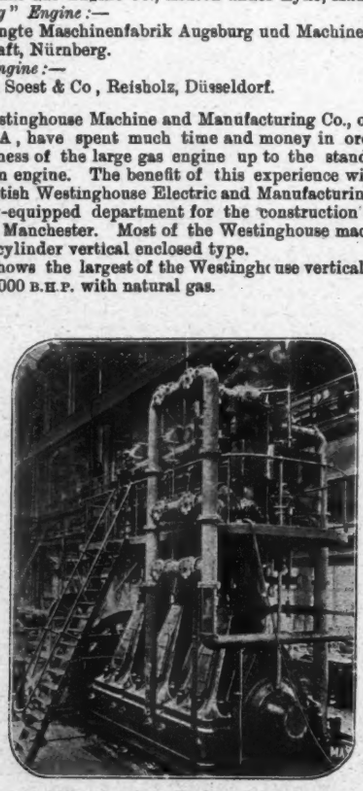


Fig. 9.

A new horizontal two-cylinder double-acting Westinghouse engine has recently been introduced, and fig. 10 shows a most interesting example of this type of gas engine direct-coupled to an alternator. All working parts are under observation and are easily get-at-able, and the design embodies a great deal of experience.

At Walthamstow electricity works there are four 100-H.P. direct-connected Westinghouse gas engine sets, and three additional sets of 250 H.P. are now erecting. The demand has increased so rapidly, that from the start they have operated without any spare capacity in the station, yet there has never been a shut-down; and the whole installation is, if anything, more reliable than a similar steam installation would have been. The plant is located in the midst of residences, but there has been no trouble whatever from noise of exhaust or vibration.

Mention has already been made of six 1,000-H.P. gas engine gas compressors, for compressing natural gas with natural gas in America. Mr. E. C. Luffkin, manager of the Snow Steam Pump

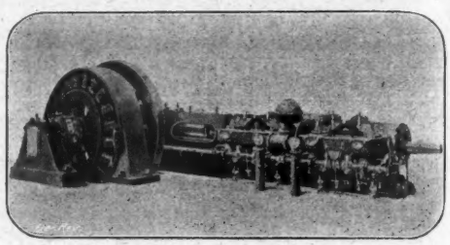


Fig. 10.

Works, of Buffalo, has been kind enough to send me the following particulars:—

Each machine has four single-acting power cylinders, 25 in. in diameter by 48 in. stroke. All four connecting rods connect to the main crank pin, two cylinders being on one side and two on the other. Another crank is formed at the other end of the main shaft, from which are driven the compressor cylinder pistons. This crank is 90° from the power crank, so that the period of maximum power and maximum resistance are nearly coincident. The normal speed of the machine is 100 revolutions per minute. Compression in the power cylinders is carried to 100 lbs. per square inch, and the explosion pressure is between 400 lbs. and 450 lbs.

The first two machines were governed by throttling the mixture; the last four machines have been modified by the addition of an automatic cut-off valve, which automatically cuts off the supply of mixture according to the power required, the closing of the cut-off valve being regulated by the governor, which can give a cut off of one-eighth of the stroke. Tests of these machines give a horse-power in the compressor cylinders with from 8½ cubic ft. to 9 cubic feet of natural gas per hour (calorific value, 1,050 British thermal units per cubic foot). The combined mechanical efficiency is 82 per cent. All parts in contact with hot gases are water-jacketed, and the machines have run well right from the start.

*(To be continued.)*

## INSTITUTION OF ELECTRICAL ENGINEERS.

### NOTES ON THE TESTING OF TRAMWAY MOTORS, AND AN INVESTIGATION INTO THEIR CHARACTERISTIC PROPERTIES.

By Michael B. Field, Member, A.M.Inst.C.E.

(*Paper read at Glasgow, May 13th, 1902.*)

Very little attention is paid as a rule by British tramway engineers to the determination of the characteristic properties of the motors they purchase. The author has known cases where important contracts have been decided in favour of one firm or another because the particular motors offered have been rated higher than those of other competitors, when in all probability a full load test would have shown the accepted motor to be not one bit superior to those rejected. It is often considered sufficient by the tramway engineer to have one sample equipment of the new type proposed, mounted on a car and tried on the street. If the speed be about right, the motors show no signs of violent sparking, and do not become excessively hot towards the end of the day's working, the test will often be considered as satisfactory. Engineers sometimes specify that the equipment shall be capable of propelling a car of given weight over a given route with a stated number of stops for not more than a stated energy consumption expressed in KW.-hours, the supply voltage being 500. Any one who has made such tests will appreciate how entirely the results lie in the hands of the motorman.

The author is of the opinion that the most satisfactory manner of arriving at the merits of the individual types is to supplement the above tests, taken on the road, by others carried out on the same motors mounted on a testing frame specially arranged for this purpose.

It is generally recognised now that it does not pay to put in motors which, although capable of doing all the work required of them without undue sparking, nevertheless heat more than 60° C. in so doing. There is consequently a liability with different manufacturers to rate their motors unequally. One, for instance, may call a motor a 40-H.P. motor because it is capable of delivering up to 40 H.P. intermittently, while another would call the same motor a 20-H.P. motor because it was not capable of giving out more power for any length of time without seriously heating the insulation. In order to avoid vagueness of this description American firms have adopted the following convention for rating tramway motors:—The rating of a motor is that H.P. which it will give out continuously for one hour under working conditions with a rise of

temperature measured with a thermometer nowhere exceeding 75° C., provided the atmosphere is not more than 25° C.

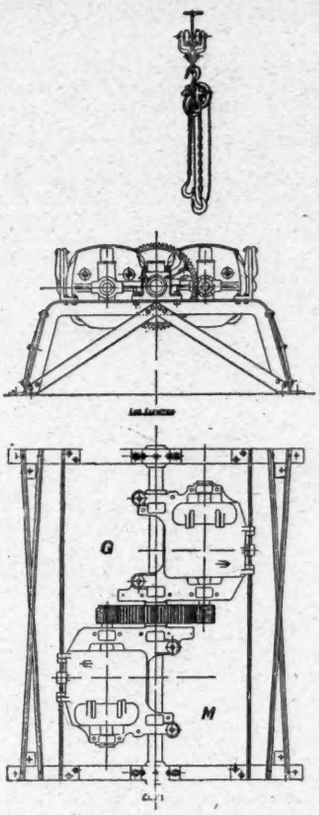



Fig. 1.—Testing Frame for Tramway Motors.

When testing such motors stationary (*i.e.*, not mounted on a car), the ventilation and cooling facilities are manifestly less than would be the case on the road. To counterbalance this the lid above the commutator is usually left open, which has been found by experience to give a fairly correct compensation for the altered conditions.

The author has adopted this as a basis of comparison of a number of different types of tramway motors in the past, and proposes to illustrate in this article how readily such motors may be quickly tested, and all their characteristic properties ascertained, in a practical workshop manner.

The motors under test are erected on the testing frame shown in fig. 1, one of the gear wheels supplied with the equipment being used for the purpose. M works as motor, driving G, which works as generator, and is loaded on a water resistance. The current, after traversing the armature and field of M, passes also round the field of G. M and G being exactly similar, having the same ampere-turns on the field, and running at the same speed, it may be assumed that the iron and friction loss in each is the same. This is very important, as it enables us to arrive at the efficiency of M, and at the same time to separate out the losses far more accurately than can be done with the Hopkinson method.

For example, if we wished to determine the efficiency at 500 volts, 50 amperes, by means of the Hopkinson method, we could

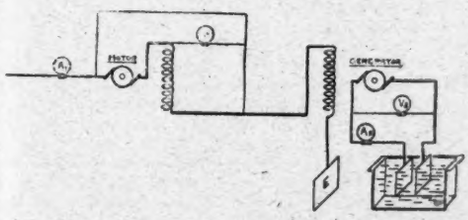


Fig. 2.

either supply the losses mechanically by driving the combination by means of a belt, or electrically by including in the circuit an additional E.M.F. Suppose at 50 amperes the $c^2R$ loss amounts to 9 per cent., and the gear and iron loss to 8 per cent., *i.e.*, efficiency of the motor = 83 per cent.; then in the first case it would be necessary to weaken the field of one motor by 18 per cent., and in the second case by 16 per cent. Under these circumstances it would be manifestly incorrect to take the square root of the combined efficiency as the efficiency of each motor.

Fig. 2 shows the diagram of connections for the method above described, and illustrated in fig. 1.

If $_mR_a$ = resistance of motor-armature.
$_gR_a$ = " generator-armature.
$_mR_f$ = " motor-field.
Then $A_1V_1$ = input. $A_2V_2$ = output.
$A_1V_1 - A_2V_2$ = total loss in motor and generator (but exclusive of generator field).

Subtracting from this the loss $A_1^2\ (_mR_a + _mR_f) + A_2^2\ _gR_a$ or the known ohmic losses, we have as a remainder the total loss in motor and generator covered by hysteresis, eddies, friction, windage, &c. But for reasons already given, we may with very great accuracy apportion this loss half to the motor and half to the generator. The efficiency of the motor is then easily calculated. The voltmeter, *v*, allows of the resistance of the motor field being taken with each reading of input, output, &c.; the resistance of the armature is best taken at the beginning and end of each series of tests, when, if time readings be also taken, the actual resistance of the armatures for any particular reading may be easily found by interpolation. By taking simultaneous readings of supply voltage, current-input, speed, &c, we can construct curves for kw.-input, efficiency, hence h.p.-output. Then by aid of the speed curve we obtain tractive effort, and the voltampere characteristic for any desired speed.

With the exception of the last named all other results should be reduced to a standard voltage, say, 500, and a standard temperature, say, 20° C. This may be readily done, as the following example will show:—

Take $A_1$ = 50 amperes.
$V_1$ = 490 volts.
$_mR_a$ = ·457 ohm determined by interpolation from initial and final readings, being approx. at 47° C.
($_mR_a$ = ·414 ohm at 20° C.).
$_gR_a$ = ·446 ohm determined by interpolation from initial and final readings, being approx. at 40° C.
($_gR_a$ = ·414 ohm at 20° C.).
$_mR_f$ = ·541 ohm determined by interpolation from initial and final readings, being approx. at 74° C.
($_mR_f$ = ·448 ohm at 20° C.).
$A_2$ = 40 amperes.
$V_2$ = 421 volts.
Speed = 422 r.p.m.
In this case the input = 24·5 kw.
" " output = 16·84 kw.

The actual total ohmic loss in armature and field of motor = $50^2 \times (·457 + ·541)$ = 2·5 kw., and in generator armature = $40^2 + ·446$ = ·714 kw., hence the total iron, friction, and windage loss = 4·45 kw.

Now, of the 490 volts supplied to the motor, 50 volts are required to overcome ohmic resistance, leaving a back E.M.F. of 440 volts. If, however, the supply had been 50 amperes at 500 volts and the temperature 20° C, the back E.M.F. would have been 457 volts, *i.e.*, the speed would have been 439 r.p.m. instead of 422 r.p.m. We may then with great accuracy increase the iron and friction

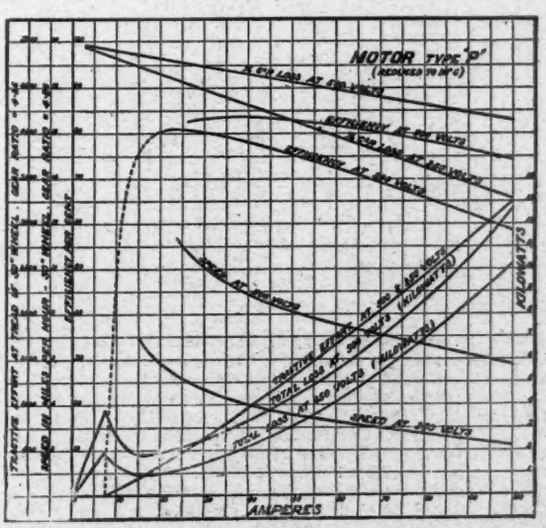



Fig. 3.

losses found above in this proportion, and, dividing by two, we obtain 2·31 kw. as the motor iron and friction loss at 50 amperes, 500 volts, 20° C. Using now the true values of the armature and field resistances at 20° C., we obtain as the corrected efficiency of the motor at 500 volts 50 amperes and 20° C., the result of 82 per cent.

Following this up, we should get with a 4·86 gear reduction (14 : 68) and 30-in. wheels, a speed of 8·1 miles per hour, an output of 27·5 h.p., and a tractive effort at the tread of the wheel of 1,275 lbs., making no deduction for journal and rolling friction of the car truck. Tables I.—VIII. [here omitted] give the readings taken recently during tests on two different types (say P and Q), together with calculations thereon, while figs. 3 and 4 show the various properties

of the motors represented as curves, reduced to 500 volts and 250 volts respectively, and to 20° C. In plotting the tractive effort curves no allowances are made for journal and rolling friction. In making calculations, it is therefore necessary to deduct 15 to 20 lbs.

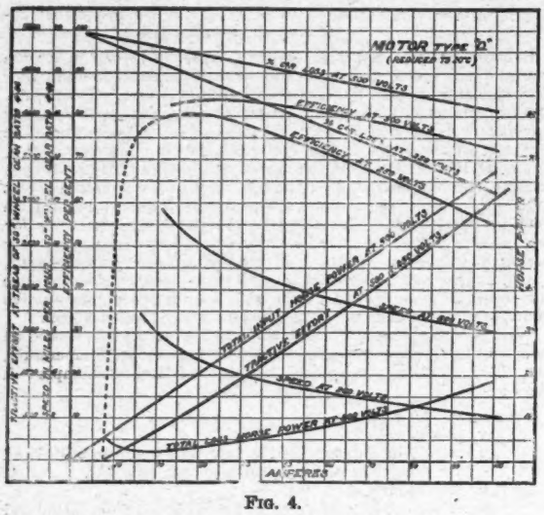

MOTOR TYPE "Q"
(REVISED TO 20°C)
% ON LOAD AT 500 VOLTS
EFFICIENCY AT 500 VOLTS
EFFICIENCY AT 250 VOLTS
TOTAL INPUT HORSE POWER AT 500 VOLTS
TRACTIVE EFFORT AT 500 VOLTS
SPEED AT 500 VOLTS
SPEED AT 250 VOLTS
TOTAL LOSS HORSE POWER AT 250 VOLTS
AMPERES

Fig. 4.

per ton dead weight from the total tractive effort of the two motors, as given by these curves. This gives the effective tractive effort, producing acceleration, or available for overcoming a grade, as the case may be.

The leading features of the motors P and Q are as follows:—

| | P. | Q. |
|---|---|---|
| Diameter of armature ... ... ... | 346 mm. | 345 mm. |
| Length of iron of armature ... ... | 190 mm. | 180 mm. |
| Number of slots ... ... ... ... | 37 | 53 |
| ,, commutator bars ... ... | 111 | 105 |
| ,, armature coils ... ... ... | 37 × 3 | 105 |
| Number of poles ... ... ... ... | 4 | 4 |
| Gear ratio ... ... ... ... ... | 4·86 | 4·86 |
| Weight of motor (without gear and gear case) ... ... ... ... ... | 1,856 lbs. | 1,924 lbs. |
| Weight of armature and pinion ... ... | 476 lbs. | 478 lbs. |

Fig. 5 shows the connections for carrying out the 250-volt test, current being taken from the 500-volt supply. By adjusting the three plates in the water tub suitably, 250 volts may be maintained at the terminals of the motor with any desired current strength.

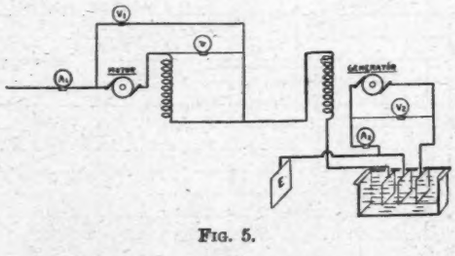



Fig. 5.

With the arrangement shown in fig. 5 a whole series of tests may be carried out at different voltages. If the iron losses be separated for each reading and plotted, a set of curves can be obtained showing the variation of iron and friction losses with speed for each field strength. Then, adopting Kapp's method, viz., plotting loss divided by speed, or back torque with speed, it should be possible to separate out the Foucault current losses from the total iron and friction loss. (See Note 1 at end of Paper).

For determining the starting current of a motor (this being the starting point of the efficiency curve), one motor is removed entirely from the frame, and sufficient resistance introduced into the circuit of the other to bring it just to the point of starting. It will be shown later that the determination of this starting current is of considerable importance.

It is to be noted that the method of testing already described depends entirely on the assumption that the motors M and G are sufficiently similar, that with equal field currents and the same speed, the E.M.F. generated in each armature is the same. A very slight difference in the length of the air-gap of the two motors would make this an unwarrantable assumption; but the author has found that, with motors manufactured by good firms, the assumption is well founded. In any case, it is easily tested. The supply voltage to motor M and the drop in volts in the motor itself are known, hence the back E.M.F. Similarly the terminal volts of G, and lost volts in armature of G are known, hence the "generated volts" of G can be determined. Since in both machines the brushes are exactly in the neutral position, the back E.M.F. of M should be the same as the "generated" E.M.F. of G if the above assumption be correct.

Tables IX. and X. [here omitted] which have been worked out for the two types of motor "P" and "Q," show how nearly the E.M.F.'s of the two motors of similar type are in agreement with one another.

In this connection it will be well to point out that a difference of 5 per cent. in these E.M.F.'s will not produce an error in the total efficiency, calculated as already explained, of more than 0·2 per cent.

In specifying efficiencies it is important to specify the temperature at which the test is to be taken; at the end of the hour's heat run, for example, the resistance will often be 30 per cent. higher than at the beginning, which may mean a diminution in the efficiency of fully 3 per cent.

Fig. 6 shows an independent method of obtaining the torque curve that I have occasionally used. The cast-iron pulley of the

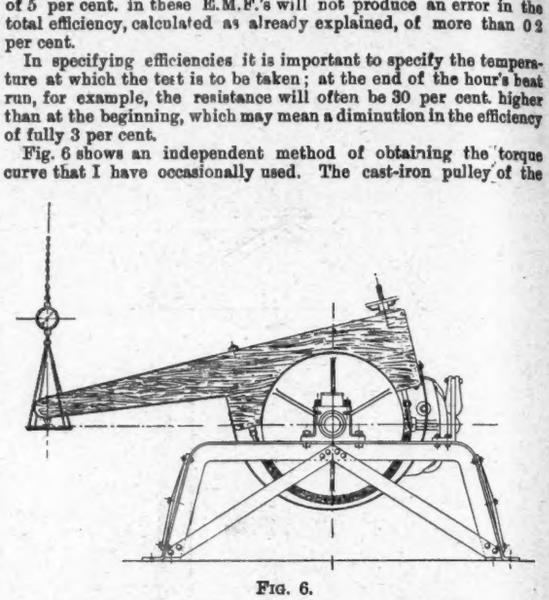


Fig. 6.

Prony brake is hollow, and partly filled with water, which effectively keeps down the temperature of the brake blocks within reasonable limits. I have used such a brake up to 100 H.P. The length of the arm in this case is 5 ft. 3 in., this being so chosen in order that the lbs. pull × revolutions per minute ÷ 1,000 = H.P. The diameter of the cast-iron pulley is 30 in., so that it exactly corresponds to a car wheel, the force at the tread being that indicated in the spring balance, multiplied by 4·2 and corrected for the weight of the lever arm. It is sometimes convenient to arrange a balance weight to counter-balance the weight of the lever arm, so that no correction is needed for this.

Returning now to the purely electrical method, I have found that for carrying out the one-hour heat run, it is most convenient to employ a special switchboard, fig. 7, in which all the necessary connections are made once for all, the measuring instruments, after being standardised, being dropped into pockets and connected in circuit.

Before the commencement of the test (which we will suppose is being made to determine the rise of temperature after one hour at

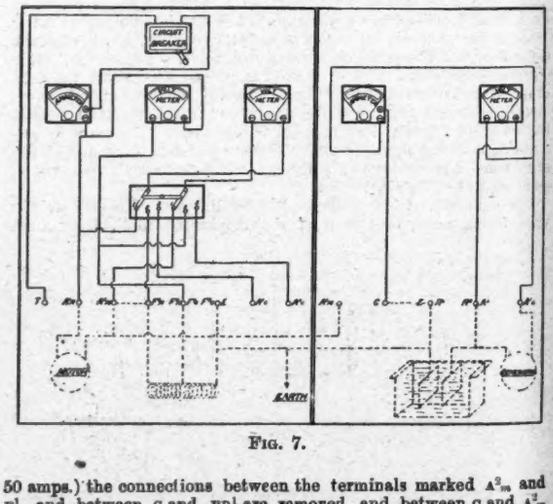



Fig. 7.

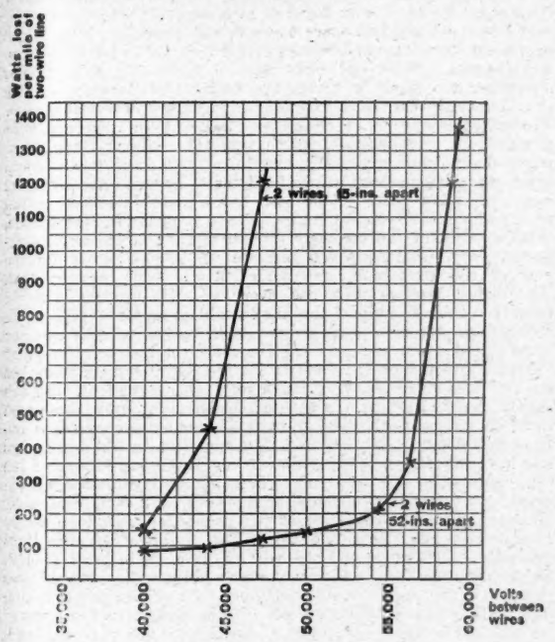
50 amps.) the connections between the terminals marked $A^2_m$ and $F^1_m$ and between C and $EB^1$ are removed, and between C and $A^2_m$ established. The current is now adjusted to 50 amps., and readings are taken with the three-way switch in positions 1 and 3. This gives the initial resistance of the two armatures, including carbon brushes and brush contacts (care having previously been taken that brushes are well bedded and not canted). A similar test is taken after the hour's run to determine the final resistance. If the rise of temperature as determined by rise of resistance be desired, it is best to have a copper brush that may be slid in in place of the carbon brush, as better contact will then be obtained.

*(To be continued.)*

## THE PHYSICAL LIMITS OF ELECTRIC POWER TRANSMISSION.

In the October issue of the *Engineering Magazine* Mr. Alton D. Adams discusses what he calls the "Physical Limits" of electric power transmission, by which he means the limit imposed by the highest voltage it is practicable to employ. After giving a list of the principal extra high voltage transmission schemes in operation, including the St. Maurice to Lausanne line, with its 10 continuous-current dynamos in series giving 20,000 volts, a 35-mile line in Utah delivering three-phase alternating current at 40,000 volts, and a 218-mile line in California transmitting alternating current at 40,000 to 60,000 volts, he points out that transformers have been worked experimentally up to and over 100,000 volts. Assuming 100,000 volts to be a practicable transformer pressure, the limit, so far as the line is concerned, has not yet been reached.

The principal factors which determine this limit are temporary arcing between the several wires on a pole, and the loss of energy, due to leakage from one wire to another. It is, of course, overhead transmission that is under consideration.




Arcing generally starts at the cross-arms, and may be caused by heavy sea fog, salt deposit, or defective insulators. A portion of the 40,000-volt line in Utah, referred to above, passes a former basin of the Great Salt Lake, and the dust which settles on the insulators, being charged with salt, gives rise to destructive arcs between the wires; although these are arranged at the corners of a triangle having sides 6 ft. in length.

On the subject of leakage between overhead wires, the author quotes from a paper by Mr. Scott (Vol. xv., T.A.I.E.E.).

Mr. Scott made tests on a two-wire pole line 11,720 ft. in length, of the energy loss between the wires when subjected to various pressures, and when spaced at distances of 15, 22, 35 and 52 in. apart respectively. It is a pity that Mr. Adams did not reproduce the whole of these results, as they form the best part of the paper. The results for the two extreme cases only are given—viz., those in which the wires were 15 and 52 in. apart respectively; and as the figures are not given in tabular form, but spread over two pages of explanation, they are most difficult to follow. If plotted in curve form, or even tabulated, the results would have been far more instructive and intelligible, and the whole would have occupied just one-quarter the space taken up by the author for the moiety.

We have constructed the above curve and the following table from the figures given:—

| Volts between the two wires. | Watts lost per mile of two-wire line. | |
|---|---|---|
| | Wires 15 in. apart. | Wires 52 in. apart. |
| 40,000 | 150 | 84 |
| 44,000 | 413 | 94 |
| 47,300 | 1,215 | 122 |
| 50,000 | — | 140 |
| 54,600 | — | 225 |
| 58,800 | — | 1,215 |
| 59,300 | — | 1,368 |

"To reduce this leakage," says the author, "it is simply necessary to give the path from wire to wire through the air greater electrical resistance by increasing its length, that is, by placing the wires at greater distances apart."

The limit to the length of cross arms attached to one pole is assumed to be about 12 ft., giving a distance of 10·5 ft. between the wires. This would involve very long and heavy poles, as the wire at the apex of the triangle must be 10·5 ft. from each of the two lower conductors. The next step would be to erect two lighter poles 20 ft. apart with a 30 ft. arm fixed across the two, the wires being attached to this, about 14 ft. apart.

There are obvious objections to this arrangement, so the author proposes a separate pole for each conductor, and considers that three poles, say, 30 ft. long each, with a 7-in. top, would not cost much more than one 35 to 40-ft. pole with an 8-in. top.

By this method of line construction, "two or three times the maximum voltage of present practice" could be carried, and "the physical limit of electrical transmission would be forced back to the highest pressure at which transformers could be operated."

But what about the *commercial limit?* It surely cannot be seriously argued that a 300-mile line of 30-ft. posts can be erected for "only a moderate percentage" in excess of a 100-mile line of 35 to 40-ft. posts, and that the cost of depreciation on the two lines would be about the same! The article in the October *Cassier's Magazine*, by the same author, on "Costs of Electric Power Transmission," might be taken as an antidote to the above.

## METROPOLITAN ELECTRIC SUPPLY COMPANY'S ARBITRATION.

The arbitration between the Metropolitan Electric Supply Co., Ltd., and the St. Marylebone Borough Council as to the price to be paid to the company for the Marylebone portion of their undertaking was resumed on Monday, October 20th, at the Surveyors' Institute, St. George Street, Westminster. Mr. C. A. Russell, K.C., is the umpire, and Mr. Robert Vigers and Mr. W. C. Ryde are sitting as arbitrators. Mr. Balfour Browne, K.C., Mr. Cripps, K.C., Mr. Ernest Moon, K.C., Mr. Sarjent and Mr. A. T. Lawrence are appearing for the company; while the Marylebone Borough Council is represented by Sir E. Clarke, K.C., Mr. Fletcher Moulton, K.C., Lord Robert Cecil, K.C., and Mr. A. B. Cane.

Mr. L. E. Halsey, examined by Sir E. Clarke, said he was a member of the firm of Price, Waterhouse & Co., chartered accountants. He had been engaged in investigating the accounts and tables which had been put in in the case. He had had access to the books of the company relating to the Marylebone area and the other areas in which the company operated; and as far as possible he had checked the calculations that had been put in by the company. In the main he found those calculations arithmetically correct. From the calculations he found there was a net profit earned in 1901 of £22,768 4s. 1d. The revenue derived from sale of current in the Marylebone portion of the undertaking in 1901, after allowing for depreciation and interest upon outside capital and after adjustment of price of the mid-London scale, he estimated at £97,024 7s. 9d. In arriving at that figure, he had taken the number of units sold to traders in mid-London, and calculated the rate per unit derived from those sales.

The Umpire said the tribunal would like a little more detail.

Witness said he would give the figures. The total sales in mid-London were 3,628,883 units, and the money corresponding to that was £66,574. From that he deducted the private lighting and the bulk contracts—307,479 units. The money corresponding to that was £6,505. Deducting those from the previous figures, it left for the traders 3,321,334 units, and the revenue £60,069, which was a rate of 4·35d. per unit. Dealing with the Marylebone figures in the same way, he found the trader's rate 4·87d. The number of units was 2,938,564. The difference in price would be seen to be ·52d. Working out that 52d. on 2,938,564 units, they got the figure of £6,365, which was the amount of the extra price charged to traders in Marylebone. He was next asked as to Table VIII., which was an estimate of the net profits of the Marylebone undertaking after providing for depreciation and interest on works and plant used outside the area, and the consequent estimated value of the undertaking based upon the rate of the earnings of the whole of the company's undertaking, and he gave the profit at £15,289 14s. 6d. From that had to be deducted the interest on the proportion of the debenture and loan capital invested in Marylebone plant, which he took at 4 per cent., and that left available for ordinary dividend £11,497 14s. 6d. Assuming that the price which was paid at that time for the shares, and which gave 3·86 per cent. of profit, represented the true expectation of interest, he applied the 3·86 to the figure of £11,497. That would give a capital value of £297,869, to which had to be added the value of the debenture stock and the loan capital at the time. According to that, the value of the Marylebone undertaking was £401,101.

The Umpire: The basis of almost all these calculations seems to be Stock Exchange quotations?—Witness: Yes.

The Umpire: And the result of the calculations seems to be to show that the Stock Exchange quotation was wholly wrong?

Sir E. Clarke: The Stock Exchange quotation is originally wrong to some extent, and generally higher than it ought to be.

The Umpire: You get the 3·86, a figure constantly used afterwards by a calcucation based on a Stock Exchange quotation of 13½. Now, if that had been 12 or 10, you would not have got 3·86?—Sir E. Clarke: No.

The Umpire: And the rest of the table is to show that it ought to have been something a good deal lower than 13¼?—Sir E. Clarke: No, not lower than that, assuming the company's calculation to have been correct, and the distribution of dividend to have been justified.

The Umpire: That merely transfers the blame to the company's accounts from the Stock Exchange quotation. I do not care whether the Stock Exchange was misled or over-estimated.—Sir E. Clarke: It shows that at that time people were investing in this to get 4 per cent. or 3·86, as the case may be. If that was the rate at which these would sell in the market, in arriving at the capital value of the undertaking you should apply that according to our suggestion. Suppose a company said they would distribute £50,000 in profit, and were not entitled to do it, the price of the shares would be very high, but, of course, it would not affect the percentage which could be raised. Increasing the amount of the money distributed in dividend does not alter the percentage on the price given for the shares, because the price rises at once.

The Umpire: Then, to see if I understand it, do you mean the result arrived at is the same as if what you had done was to agree to 13¼, and say if, instead of the profit being available for distribution was £44,000, it had only been £26,000, the price would have been so much less.—Sir E. Clarke: Yes, that is so.

Mr. Fletcher Moulton: The Stock Exchange quotation would be based on the profits.

Mr. Cripps: No, no.

The Umpire: I only wanted to know if the same result would be arrived at.

Sir E. Clarke: I will put it to Mr. Halsey in that way—it is another way of proving it.

Witness: Yes, it might have been put in that way, with the same result.

It would have come to the same thing?—Yes.

The Umpire: That is assuming 13¼ was the correct view of value to take if the profits were £44,328. Of course, a lower price would have been the price taken if it were known that the true profits were only £26,000. Witness: Exactly.

Sir E. Clarke: And that accounts for the difference between the value of the capital at market values—that is the whole undertaking so you cannot compare the figures; but that accounts for the difference between the proportion which Marylebone would have of the whole undertaking at market values, and the figure at which you put the real value.—Witness: Yes.

Examined with respect to the tables which had been put in showing the company's consumers, the witness said that the amount of current used per consumer had decreased in the last four years. In 1898 it was 964 units, and in 1901, 849. He had made an investigation as to the amount of current taken by different groups of customers and the average per customer, and he found that whereas the number of units consumed by the larger customers increased on an average at a rate of nearly 9 per cent. per annum on the previous year's supply, those taken by small consumers increased at a rate under 3 per cent.

The Umpire: What do you take as large or small?—Above or below £100; those who took above £100 in 1901 were the large, and the rest were the small. Continuing, witness said he had examined the figures with regard to the comparison of prices in Marylebone and mid-London, and arrived at the figure ·52d., which he thought represented the advantage which mid-London had over Marylebone. He found that in mid-London there were over 40 accounts of over 10,000 units. The total consumption was 1,276,865. Of those, three, consuming 51,960 units, were supplied under 4d.; 27, consuming 933,478 units, were supplied at 4d.; and 17, consuming 291,697, were supplied at between 4·01d. and 4·5d On the other hand, in Marylebone there were 49 such accounts of over 10,000, instead of 40, with a total consumption of 1,210,717. Of those, four, consuming 31,774 units, were supplied under 4d.; 12, consuming 336,857 units were supplied at 4d.; 12, consuming 314,437 units, were supplied at between 4·01d. and 4·5d.; and 30, consuming 527,649 units, were between 4·51d. and 6d.

Mr. Cripps said that as regarded those figures he had not had the details before him, and he would ask their accountant to look into them with Mr. Halsey, and very likely they would be agreed upon. He could not say if there was to be any dispute.

The Umpire remarked that the analysis of the figures might be very important.

In further reply to Sir E. Clarke, Witness said he had not been able to ascertain accurately what the cost of generation for the Marylebone area had been, as it was impossible to ascertain accurately the disposition of the current generated. The cost of generation of the whole was given as £144,681. If the company's estimate as put in for loss in generation and transmission and in the number of units generated were accepted as correct, the units generated to supply Marylebone would in 1901 have numbered 8,097,753 out of a total number generated of 17,909,995. On that basis the cost of generation for Marylebone would be £65,375.

The Umpire: You say cost of generation, Sir Edward—do you mean as distinguished from distribution and management and general charges?

Sir Edward Clarke: The total cost, including distribution.

Cross-examined by Mr. Cripps, Witness said that in taking over a business of that kind he would look into the market value of the company.

---

On Tuesday, October 21st, Mr. Arthur Wright, consulting engineer for the Boroughs of Brighton, Stepney, and Marylebone, gave evidence. Replying to counsel, he said that he had had long experience in connection with electric lighting work. His experience had been chiefly with central station management. He was thoroughly familiar with the documents and evidence in this case. With regard to the steam generating plant used by the company in Manchester Square, he said he believed the turbos were of a very uneconomical type. He understood they consumed twice the amount of steam per kilowatt-hour a modern engine would consume. The effect of that was to make the generation of electricity in Manchester Square exceedingly expensive, owing to the absence of condensation. He also thought that they were too small a size for the business they might be called upon to do. They occupied a great deal of space, and considering the total generating capacity they were extravagant in floor space. The company had some steam plant at Rathbone Place, consisting of some high-speed engines of exceedingly small size considering the business they had to do. Their largest size, he believed, was 120 KW., which was altogether too small a size for a modern business dealing with 2,000 KW.

The Umpire: Do you make any suggestion as regards Manchester Square and Rathbone Place as to what unit you should take?—I think if they had a 1,000 KW. set, they could have got much more generating capacity in those two sites. In a business dealing with 5,000 KW., anything under 1,000 KW. is a mistake, I think. Continuing, witness said, with regard to the modern transforming plant in Manchester Square and Rathbone Place, he thought the same fault applied—the units adopted were too small for the business they did. To have only 100-KW. sizes meant a large expense in switchgear, a large floor space covered, and consequently a larger amount of attendance and repairs than if they put in 500 or 600-KW. transformers. What had been put in quite lately seemed to be altogether too small to tackle the business of Marylebone. He should imagine that that also tended to increase the cost of repairs. The motor-generators in Rathbone Place—14 in number—were situated in a most unsuitable place, very hot, and everything led to uneconomical working. They were in a crowded place, and could not be expected to work as efficiently as a larger motor-generator could. Dealing with the question of the probable increase of the supply of electricity in the future by the company in Marylebone, witness said that the company estimated that, including motive-power, they would get an increase of 940,000 units by the end of the concession, or nearly 46 per cent. greater than the greatest increase they had ever had. He thought it would be unreasonable to suppose that they would go on for 30 years. He thought the present rate of increase might be maintained for two or three years if the company continued their reduction in prices at the same rate as they had done during the last five or six years, but the increases depended very much upon the reductions. In the case of electric lighting, the people to come on first were those who came on independently of cost, but that number was very soon exhausted. Electric lighting had no competitor in wealthy houses and in certain shops, but that was a very small proportion of the total population. In order to get the bulk they must reduce the price far below the price which the company had put in their table. Unless they did that he thought the population would be lit by incandescent gas. He did not think they could get electric light generally taken up at a price varying from 5½d. down to 4½d. Incandescent gas, as it was now probably going to be managed, was going to largely interfere with the great bulk of the people taking electric light at anything above 4d. Unfortunately in this country we had had no experience of the incandescent gas well managed, but he was certain from what he had seen abroad that incandescent gas would be a very strong reason why the bulk of the people would not take electricity at 4d., or anything above 4d.; as regarded public lighting incandescent gas had been a success. The arc lights had not succeeded in the main streets, but even electricity at 1½d. could not compete with well-managed incandescent gas. As to the use of incandescent gas in shops, he was of opinion that the better class shops would use electricity, but when they were exhausted—and they were a very small proportion of the total population—they came to a class that considered cost above everything, and he thought that incandescent gas at anything like 3s. a thousand would certainly get the bulk of the lighting unless electricity was supplied at very much less than 4d. In Berlin, where electricity had been as well supplied as at any place in Europe, and, he believed, comparatively cheaply, he did not find that one shop out of 20 in the principal streets was electrically lit. It was all done now by incandescent gas, showing that, when incandescent gas was managed as it was managed there, it was the most serious rival electricity could have. The better class shops in Berlin were now nearly all lit with incandescent gas, but here we had never had the incandescent gas properly managed. They could give electric light cheaper if they had a more efficient lamp. The effect of that would be that they could compete with the Welsbach burner, but their field would be reduced; if they gave twice as much light with the same amount of electricity, half their field was gone at once. He could not say if people would take more light then or reduce the amount. Among the poorer classes he thought they would reduce the amount probably; among the better class they might shade the lamps, or cover them up more, but in the future the new lamps must reduce the possible consumption of electricity. In Brighton they were just commencing to use the Nernst lamp both for street and private lighting. He was aware that Mr. Ferranti had made a suggestion that small consumers would afford an increasing field for the supply of light, but he did not think that he meant that the small consumer would come on at the present price—that would have to be considerably reduced. As to the probable use for power, he did not think Mr. Conacher's estimate of eight million units, which was 100 times the present consumption, in 30 years' limit was ever likely to be obtained. The various uses to which it had been suggested that electricity might be applied, such as for heating water, heating rooms, and driving fans, he regarded as impracticable in a commercial sense. Its use for cooking was more probable than for heating, but

he did not think it would ever amount to much. The cost of the cookers and the absence of ventilation in the electric kitchen would interfere with that ever being a big business. In London it was not safe to trust to their lighting plant for a power demand, because an ordinary fog would interfere with it absolutely. As to the use of electricity for lifts, he considered that a lift was the worst kind of consumer one could have from an electric light point of view, as it jerked the light. Regarding its use for industrial purposes in Marylebone, he did not consider that was a district where that sort of industry was likely to thrive. Manufacturers were likely to go to districts where electricity was much cheaper, and where land and labour were cheaper. He looked upon Marylebone as unsuitable for factories. At Shoreditch and Stepney the power supplied was at a much lower rate, and he thought that sort of industries would go where electricity was cheap. Regarding automobiles, he thought they would have to be charged in yards by skilled attendants. He did not think it was possible to contemplate charging electric cabs in one's own private stables. In the first place, the batteries required very skilful attention and rather heavy handling, and they would require to be charged probably in the middle of the night, and that would have to be done by a company. At Brighton they had sold electricity as cheaply as anywhere in England, and he thought they sold 500,000 units for motive power. They sold a great quantity for tramways but not for motive power. The population of Brighton was the same as Marylebone—125,000. They had no fixed prices. It was sold on a sliding scale, but it came out at about 2¼d. He did not believe the company would be able to maintain its present price in Marylebone if it wanted to get anything like an increase in business; 5d. now was a very high price. Municipalities in the north and in the east supplied at a much lower figure, and the effect of that would be to force down prices quite apart from competition. The average price at Brighton on the sliding scale for lighting to private consumers was 3¼d.—Adjourned.

---

On Thursday, October 23rd, further evidence was given by Mr. A. Wright. He was examined by Mr. Cane with regard to the table he had prepared, the object of which was to show that owing to the capital charges which he estimated the company would incur, and the estimated cost per unit during the next 30 years, the price which the company itself set down to supply power would be unprofitable to it. He worked out the capital cost on the basis of the £60 per 1,000 units sold which corresponded to the 20 per cent. load factor for power. This at 4½ per cent. for interest, and 1½ per cent. for provision for terminal drop, came to a charge of ·864d. per unit sold, and that being constant during the 30 years as they had taken it at the estimated average cost, was added in the last column but one of his table to the total cost per unit. In the next column they had dealt with the estimated demand for power, and without any relation to price they had estimated that 3,000,000 units for power would be the most that could be sold in Marylebone. That he should say was the estimate of the Borough Council. Personally, he thought that if they had a low price corresponding to the 1½d. or 1d. of other authorities in 30 years, it would be reasonable to suppose that they could sell something like 3,000,000 units, but it being a residential and not industrial district, he did not think more should be allowed.

The Umpire said he took it from the table that the total cost per unit column showed, with the exception of one or two years, that the total cost per unit always exceeded the prices proposed to be charged by the company.

Mr. Cripps, K.C.: That is their view.

Mr. Cane (to witness): I understand you to say, not that no company can sell power at a profit, but that under the peculiar circumstances of this company in respect to capital charges, you do not anticipate they can?—They can sell power at a profit if they fairly debit to the power supply the capital required for power.

Witness proceeded to criticise the valuation of the company of their plant. He was aware it was a part of the case of the local authority that the company were bound by their agreement to have a self-contained system in Marylebone, and he knew it would be stated by Mr. Ferranti that the company's stations were as full of plant as they could be. He thought that was an accurate statement, for they were crowded up with small plant.

Mr. Cane: Would there have been any physical impossibility in installing plant at these stations sufficient to meet our demands?—I think not, if you took out the present wasteful plant—I mean wasteful in the sense of occupying a large floor space. You can get sufficient plant to carry on the business in Marylebone at some inconvenience. I do not think it is anything an engineer would be proud of, but it is possible.

In cross-examination by Mr. Cripps, Witness admitted that in his valuation of plant in 10 years he had written off for boilers which had been properly renewed as regarded their tubes 73 per cent. of their value.

Mr. Cripps: Have you ever done such a thing in your life except for the purposes of this valuation, or heard of such a thing?—I think that is the usual rate of depreciation in estimating the value of a boiler.

Then you say in another five years these boilers will be unfit for use?—I do not think you will use them.

Do you say in five years these boilers, with properly renewed tubes, will be useless?—You will have taken them out to replace them by bigger ones. They do not wear out or disappear, but they become unsuitable for your business.

In cross-examination as to further figures in his estimates, Witness said he had taken the alternators at half the original cost, the alternators being practically scrapped, and he had assumed as the value of the turbos to the company one-third of the original cost, owing to its being an obsolete, wasteful design.

In other words as regards boilers. Though the depreciation is not calculated on the same year, and so on, what you consider is that, in that the turbo-alternators in your opinion are of a wasteful design, they would have to be renewed, and an alternative method to be introduced by the company, and so you have valued them?—Yes. He had dealt with the steam pipes in the same way as the boilers.

Mr. Cripps: The result of applying that principle is to make your capital at the present time, including preliminary expenses, and so on, £180,000?—Yes. That principle which you emphasise applies, I believe, only to the steam generating plant. The mains are valued on the ordinary depreciation rates.

Whereas your figure on your principle works out at £180,000, the figure at which this plant stands in our books is £505,000?—That includes buildings and sites.

Yes, I beg your pardon. Excluding these items, and merely taking the same items you include, I am told our figure is £373,000. Your view is that the company, keeping the accounts in the ordinary way, have their capital account as regards their plant and so on, twice what it ought to be, or rather more?—The capital cost to the company had been very nearly twice the value of the apparatus and materials I saw at Marylebone. Whether the whole of the apparatus, which cost £360,000, is in my valuation, I do not know.

Examined on the question of the cost of supplying power, witness said that at Brighton the supply for power purposes was charged at the same price as for lighting. They charged 7d. for the first hour and 1d. afterwards. To a 10-hour user that came to 1·6d. They supplied for power purposes in some cases at 1·7d. That was no loss to them, but just bare cost, including capital.

*(To be continued.)*

---

## A STUDY OF POWER GAS.

Under the above title the *Engineering Magazine* in its "Review of the Engineering Press" gives some extracts from a paper on "The Generation of Motive Power in Internal-Combustion Engines and the Utilisation of Waste Furnace Gases," forming the second contribution on the subject by M. Lencauchez to the Société des Ingénieurs Civils de France.

Among the advantages claimed for the use of gaseous fuel are material economy, cleanliness, freedom from smoke, and general convenience. It is also pointed out that fuels altogether unsuited for steam-making may be utilised in the gas producer.

M. Lencauchez reviews the development of the gas producer, showing that while there is no fundamental difference in principle between the more recent producers and the earlier ones, the improvements which have been made are important ones, affecting both the more convenient operation of the apparatus and the utilisation of valuable by-products. When only air is employed for the partial combustion of the fuel in the producer, the combustible portion of the gas consists of carbonic oxide gas with only a very small proportion of hydrogen, and the gas has a thermal value of about 100 B.Th.U. per cub. ft.

When water vapour or steam is added to the air supply, the gas contains a higher proportion of hydrogen, and has a thermal value of from 130 to 150 B.Th.U. per cub. ft., while good water gas gives about 300 B.Th.U.

The most striking point in M. Lencauchez's paper is perhaps the following:—"So far as thermal economy goes, it has been found that with properly constructed engines the efficiency with very lean gas is as high, if not higher than with the richer gas, but naturally a larger engine is required to produce a given amount of power.' In this connection we may point out that a certain engine gave 80 H.P. with coal gas, and 67 H.P. with blast furnace gas, or a difference of only 16 per cent., while the thermal values of the two gases were about 600 for the former gas, and 120 for the latter.

Discussing the various forms of producers, M. Lencauchez refers to the difficulty found in the removal of the incombustible portion of the fuel, and points out that in the blast furnace this is done by means of a flux, thus removing the earthy matter in a liquid form. In regard to the use of blast furnace gas in gas engines, the same writer says that the removal of dust constitutes the most important factor, and describes several arrangements for scrubbing and washing the gas. His statement that "in some instances no purification is necessary" is somewhat misleading, though it has been adopted by many writers.

Blast furnace gas as it leaves the furnace top is in a highly-heated condition, besides being charged with water vapour and dust, and in this state it cannot be successfully applied to the cylinder of an internal combustion engine, for obvious reasons. Where it has been said to be employed without purification, it has been subject to the passage through the usual "dust catchers," and the cooling effect (therefore purifying) of considerable lengths of tubing, from 100 to 200 yards; the dust catchers and tubing constituting a crude form of purifier.

## NEW PATENTS, 1902.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, to whom all inquiries should be addressed.

22,198. "Improvements in electrically-lit signboards and the like." G. Smith. October 13th.

22,283. "Electrothermic diffusers." F. de Mare. October 13th. (Complete.)

22,238. "New form of cylindrical accumulator blocks." W. Ostermann. (S. Raudnitz, Austria.) October 13th.

22,249. "An improved method of and apparatus for the production of high frequency electric currents." R. Scharf. October 13th. (Complete.)

22,255. "Improvements in electric ignition devices for explosion engines." K. von Dreger and R. Friedlander. October 13th. (Complete.)

22,261. "Improvements relating to the method of and apparatus for armouring electric cables and the like." E. T. Greenfield. October 13th. (Complete.)

22,262. "Improvements in electrical conducting systems." I. H. Hegner. October 13th.

22,260. "Improvements in and relating to the electrification of long-distance ways, generally known as railways, and also to the electrification of street and road tramways." J. F. Smith. October 14th.

22,286. "An improvement in or relating to trolley wire cars employed in connection with the overhead system of electric traction." J. Wilkinson. October 14th.

22,296. "Improved method of and means for cooling armatures and other parts of motors or dynamos." M. Kuhl. October 14th.

22 313. "The 'Massey Automatic Electric Signal,' for tramways or railways." J. Massey. October 14th.

22,334. "Improvements relating to sparking plugs for the electrical ignition apparatus of explosion engines, particularly applicable for use in connection with motor road vehicles." A. Ford. October 14th.

22,336. "Improvements in electrical signalling apparatus for transmitting orders or signals from one remote point to another." A. F. Hauss. October 14th. (Complete.)

22,344. "Improvements in coin-freed electricity vending machines." F. H. Urry and W. Haydon. October 14th.

22,346. "An improved apparatus for indicating the presence of leaks on electric circuits." R. J. Bott. October 14th.

22,352. "Improvements relating to apparatus for locating breaks and grounds in electric circuits or for comparing the resistance of one circuit with that of another." M. J. Myers. October 14th. (Complete.)

22,356. "Improvements in retarding devices for use in connection with electrical measuring and like instruments." A. O. Benecke. October 14th. (Complete.)

22,400. "An improved electric lamp for use on cycles, motor cars, and other vehicles." R. Sinclair. October 15th.

22,421. "Improvements in electric switches." C. M. Dorman and R. A. Smith. October 15th. (Complete.)

22,426. "Galvanic double battery." H. Bley. October 15th.

22,503. "Improvement in electric and other tramcars." J. A. De Macedo. October 16th.

22,505. "Improvements relating to electrical interrupters or make-and-break devices for induction coils, and for producing electrical discharges." E. E. Bartlett. October 16th.

22,532. "Improvements in incandescent lamps." J. J. Rooney. October 16th. (Complete.)

22,551. "Improved electric signalling system." C. W. Mills and W. W. Piddington. October 16th. (Complete.)

22,555. "Improvements relating to electric insulating material." I. S. McDougall. October 16th.

22,556. "Improvements relating to electric insulating fabrics." I. S. McDougall. October 16th.

22,580. "Improved method of protecting electric cables." Drake and Gorham, Ltd. October 17th.

22,615. "Improvements in insulated connections for electric cables." L. W. de Grave. October 17th. (Complete.)

22,649. "Improved method of and appliances for operating trolley line and other switches." P. H. Dawe. October 17th.

22,657. "Improved means for applying electricity to the human body." J. W. Gibbs. October 18th.

22,675. "An improvement in electric trolley heads with a wire-finding apparatus attached." J. T. Cherry and E. H. Clive. October 18th.

22,676. "An improved house fuse box." C. H. Naylor. October 18th.

22,705. "Improved electric motor car." H. W. Hellmann. October 18th.

22,719. "Improvements in and connected with alternate current motors." V. A. Fynn. October 18th.

22,724. "An improvement in electro-magnets." G. Hollingworth. October 18th.

22,732. "Improvements in and relating to electric switches." A. P. Zani. October 18th.

22,750. "Improvements relating to electric illuminating devices, chiefly designed for use in connection with signs or the like on tramway and other vehicles." H. H. Lake. (Reversible Electric Car Sign Co., United States.) October 18th. (Complete.)

22,751. "Improvements relating to electric illuminating devices, chiefly designed for use in connection with signs or the like on tramway and other vehicles." H. H. Lake. (Reversible Electric Car Sign Co., United States.) October 18th. (Complete.)

## PUBLISHED SPECIFICATIONS, 1900.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson and Co., 322, High Holborn, W.C., and at Liverpool, price, post free, 9d. (in stamps).

15,261. "Improvements in means for producing jacquard cards, or for operating the lifting wires of jacquard looms." C. Junge. (Communicated.) Dated August 25th, 1900. 1 claim.

15,225. "Improvements in electric arc lamps." H. Bremer. Dated August 27th, 1900. 6 claims.

15,285. "Improvements in systems of electrical distribution." British Thomson-Houston Co. (Communicated.) Dated August 28th, 1900. 9 claims.

15,298. "Improvements in wireless telegraphy." C. E. Wilson. Dated August 28th, 1900. 3 claims.

15,313. "Improvements in automotor trolleys for electric current." P. B. L. Lombard-Gerin. Dated August 28th, 1900. 2 claims.

15,332. "Improvements in apparatus for stopping, starting, and reversing electric motors." W. L. Wise. Dated August 29th, 1900. 2 claims.

15,363. "Improvements relating to the electro-deposition of metals upon articles of china, earthenware, and the like." G. Cooke and J. Parr. Dated August 29th, 1900. 2 claims.

15,378. "Improvements in means for generating or converting alternating electric currents." British Thomson-Houston Co. (Communicated.) Dated August 29th, 1900. 16 claims.

15,379. "Improvements in regulating dynamo-electric machines." British Thomson-Houston Co. (Communicated.) Dated August 29th, 1900. 26 claims.

15,380. "Improvements in systems of electrical distribution." British Thomson-Houston Co. (Communicated.) Dated August 29th, 1900. 16 claims.

15,381. "Improvements in thermal electric cut-outs." British Thomson-Houston Co, (Communicated.) Dated August 29th, 1900. 10 claims.

15,382. "Improvements in systems of electrical distribution." British Thomson-Houston Co. (Communicated.) Dated August 29th, 1900. 6 claims.

15,419. "Improvements relating to the supply of current to electric vehicles by inductive means." R. Haddan. (Communicated.) Dated August 29th, 1900. 2 claims.

15,470. "Process of forming metallic electrode plates." A. J. Boult. (Communicated.) Dated August 30th, 1900. 1 claim.

15,473. "Process for the forming of electrodes." A. J. Boult. (Communicated.) Dated August 30th, 1900. 2 claims.

15,524. "A method of and means for lining wheel hubs, bearings and the like." A. Reichwald. (Communicated.) Dated August 31st, 1900. 2 claims.

15,591. "Improvements in electrical driving apparatus and in electric meters combined therewith." A. J. Boult. (Communicated.) Dated September 1st, 1900. 4 claims.

15,642. "Relates to holders for incandescent lamps." L. J. P. Hollub. Dated September 3rd, 1900.

15,660. "Improvements in or relating to electric motor wheels." R. C. Sayer. Dated September 4th, 1900. 2 claims.

15,710. "Improvements relating to electric storage batteries." H. H. Lake. (W. R. Bowker, U.S.A.) Dated September 4th, 1900. 4 claims.

15,717. "Improvements relating to electric railways working on the closed conduit system." L. Dion. Dated September 4th, 1900. 6 claims.

15,718. "Improvements relating to the preparation of conducting material chiefly designed for the manufacture of brushes for dynamo-electric machines." H. H. Lake. (J. B. Pay, U.S.A.) Dated September 4th, 1900. 21 claims.

15,721. "Improvements relating to telephone systems." H. T. Cedergren. Dated September 4th, 1900. 6 claims.

15,730. "An improved material or composition, suitable for use as an electric cement and insulator." A. Matheson. Dated September 4th, 1900. 3 claims.

15,748. "Improvements in or relating to electric switches, fuse and other apparatus in which destructive electric arcs are liable to be formed." G. W. Partridge. Dated September 4th, 1900. 6 claims.

15,752. "Improvements in and relating to electroliers, pendant and fittings or connections therefor." H. Hirst and G. H. Ide. Dated September 4th, 1900. 1 claim.

15,774. "An improved electrical signalling apparatus for fire alarm and other purposes." W. Clar. Dated September 5th, 1900. 3 claims.

15,864. "Improvements in and relating to street lamps and fittings for incandescent lamps." W. C. Hawtayne. Dated September 6th, 1900. 3 claims.

15,870. "Improvements in apparatus for producing electric waves." T. J. Ricaldoni. Dated September 6th, 1900. 3 claims.

15,874. "Improvements in means or apparatus for controlling electrically-driven lifts, hoists, cranes, pumps, or air compressors and for analogous purposes." J. Bjornstad. Dated September 6th, 1900. 4 claims.

15,888. "Improvements relating to the method of suspending the moving parts of an electric integrating meter or other instrument." J. C. Fell. Dated September 6th, 1900. 5 claims.

15,890. "Improvements in electric cable connectors." S. Beeton and M. Barr. Dated September 7th, 1900. 3 claims.

15,918. "Improvements in electrical phase transformation." British Thomson-Houston Co. (Communicated.) Dated September 7th, 1900. 3 claims.

15,919. "Improvements in electric rotary transforming apparatus." British Thomson-Houston Co. (Communicated.) Dated September 7th, 1900. 8 claims.

15,920. "Improvements in electric furnaces." British Thomson-Houston Co. (Communicated.) Dated September 7th, 1900. 5 claims.

15,921. "Improvements in electric cut-outs." British Thomson-Houston Co. Dated September 7th, 1900. 9 claims.

15,951. "An automatic switch for groups of transformers with members of various capacity." A. Schlatter. Dated September 7th, 1900. 1 claim.

15,957. "Improvements in electric motors." C. Contal and P. Gasnier. Dated September 7th, 1900. 4 claims.

16,010. "A new or improved insulating and packing material, and a method of manufacturing same." M. Raphael and L. Elias. Dated September 8th, 1900. 4 claims.

16,049. "Improvements in electric commutators." British Thomson-Houston Co. (Communicated.) Dated September 10th, 1900. 14 claims.

16,050. "Improvements in controlling high potential electric circuits." British Thomson-Houston Co. (Communicated.) Dated September 10th, 1900. 4 claims.

16,051. "Improved means for starting alternating current motors." British Thomson-Houston Co. (Communicated.) Dated September 10th, 1900. 4 claims.

16,052. "Improvements in systems of electrical distribution." British Thomson-Houston Co. (Communicated.) Dated September 10th, 1900. 22 claims.

16,061. "A device for putting into and cutting out of circuit liquid rheostats operated by means of compressed air." C. de Kando. Dated September 10th, 1900. 2 claims.

16,062. "Combined reversing switch and automatic maximum current interrupter for multiphase alternating current motors." C. de Kando. Dated September 10th, 1900.

16,117. "Improvements in signalling on railways." F. B. Behr. Dated September 11th, 1900. 3 claims.

16,127. "Improvements in and connected with dynamo-electric machines." British Thomson-Houston Co. (Communicated.) Dated September 11th, 1900. 19 claims.

16,128. "Improvements in regulating electric alternators." British Thomson-Houston Co. (Communicated.) Dated September 11th, 1900. 6 claims.

16,130. "Improvements in high-potential electric switches." British Thomson-Houston Co. (Communicated.) Dated September 11th, 1900. 10 claims.

16,164. "Improvements in electrical measuring instruments." A. C. Heap. Dated September 11th, 1900. 3 claims.

16,225. "Improvements in measuring electrical energy and in apparatus therefor." R. Kennedy. Dated September 12th, 1900. 5 claims.

16,226. "Improvements in or relating to machinery or apparatus for covering electric cables, wires and other cores." I. L. Berridge and B. Kerr. Dated September 12th, 1900. 8 claims.

16,242. "Improvements in electric wall or floor coupling sockets." G. A. G. Kent and B. G. Stewart. Dated September 12th, 1900. 3 claims.

16,290. "Improvements in and connected with electric circuits for the transmission of energy by variable currents." G. A. Campbell. Dated September 13th, 1900. 10 claims.

16,291. "An electro-magnetic regulator of the admission valves of gas or oil motors." C. D. Abel. (Communicated.) Dated September 13th, 1900. 2 claims.